

JUN 21 1943

AUTOMOTIVE *and Aviation* INDUSTRIES

JUNE 15, 1943



ON CURVES



IN PARKING



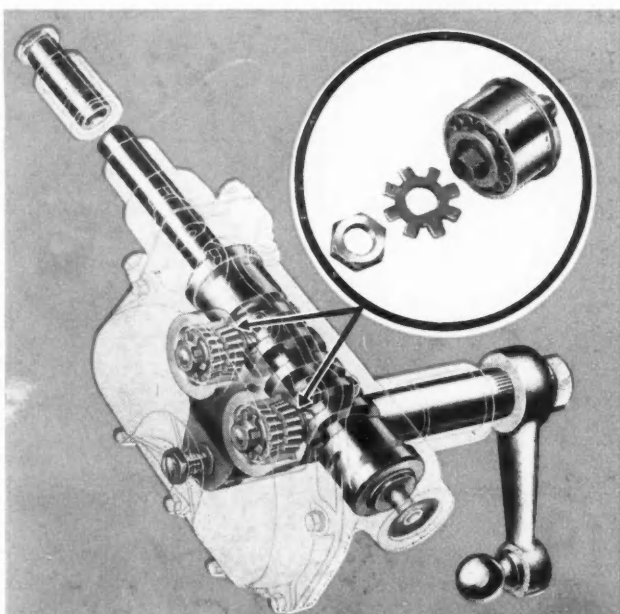
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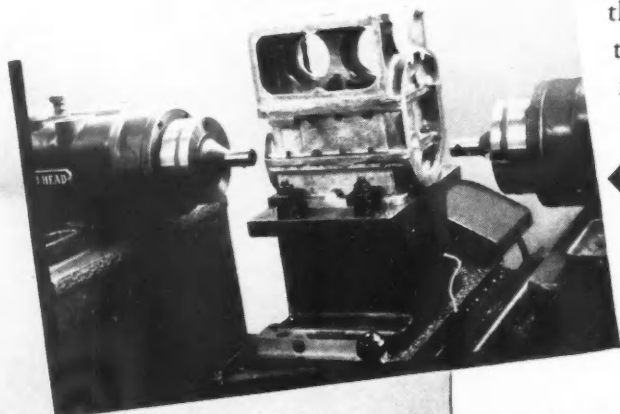
As enemy aircraft approach and the ack, ack opens up, a tiny flaw in any mechanism might mean "target missed."

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◀ *Borizing a casing for Bofors 50 mm anti-aircraft guns. First operation bores two 3.375" diameter holes spaced 4.125" apart using a cross slide of indexing. Then work is indexed 90° and two holes 1.500" are bored in line by means of opposed heads.*



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AUTOMOTIVE and Aviation INDUSTRIES

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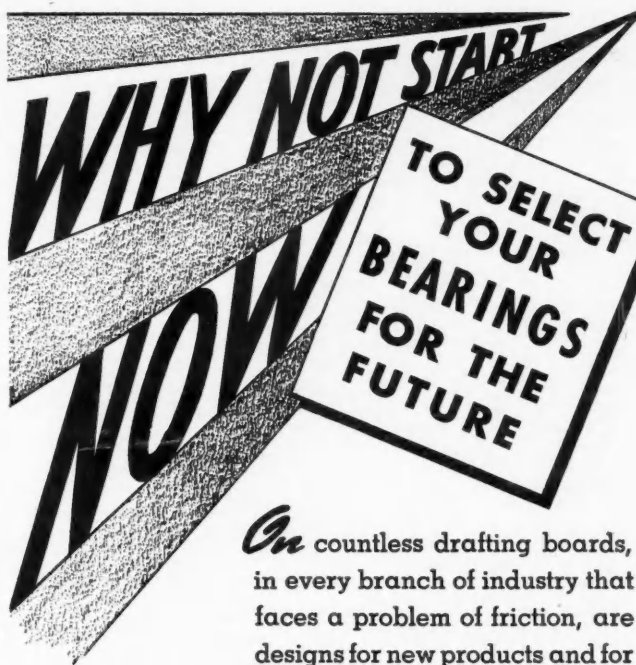
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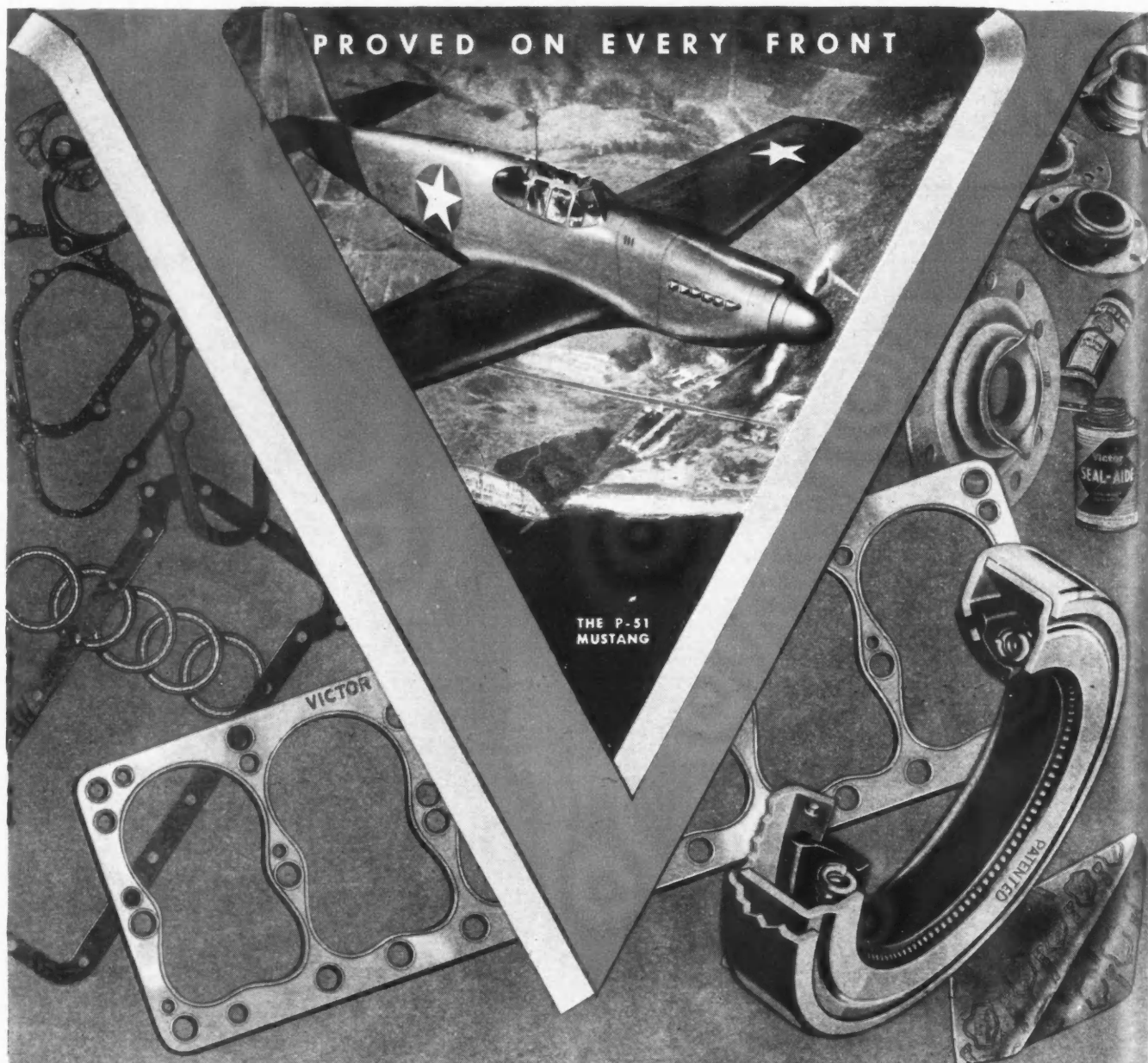
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AUTOMOTIVE and AVIATION INDUSTRIES

Volume 88 June 15, 1943 Number 12

AUTOMOTIVE INDUSTRIES

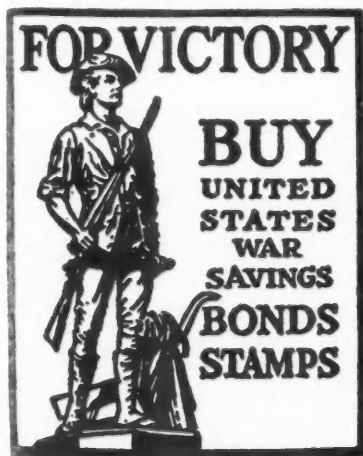
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No Postwar Designs

The automotive industry has not allowed "loose talk about extreme post-war models" to interfere with its concentration on its war jobs, George Romney, managing director of the Automotive Council for War Production, said in addressing a round table conference at the Waldorf-Astoria Hotel. Mr. Romney declared that—

"Despite repeated statements by leaders in the automotive industry that they expect to resume production on substantially the same models that were being produced when the war started, there are recurring articles in newspapers and magazines in which it is alleged that automobile companies are doing experimental work on post-war models.

"Because the nation's interest, both in the war and the reconstruction period, is directly and vitally involved, I want to emphasize at this time that I do not know of any motor vehicle company that is doing experimental work on new postwar cars. To my knowledge, every company in the industry is concentrating completely on its war jobs."



June 15, 1943

Wanted—An Air Policy

17

The aircraft industry has made great strides in the United States during recent months. In order that this country should take its proper place in the world of aviation, a start should be made now towards that goal. Here is an article filled with facts and figures that show many things that few realize. They point the way that should be followed.

How Vega Engineering Simplifies Production Methods

20

In order to facilitate the handling of production problems Vega established an organization called Production Engineering. It is completely decentralized with respect to shop departments. It has done a great job. You must read this account of its operation.

Absenteeism Under Control at Vultee

22

How this progressive organization has reduced its absenteeism to 3.3 per cent is the subject matter of this article. Many innovations were introduced and here the author tells how they all worked toward the remarkable achievement of so low a rate of absence.

The deHavilland Mosquito

26

Drawings and photographs in abundance accompany this description of the deHavilland Mosquito warplane. With its accomplishments in the line of service, it has become outstanding and in many respects unique. Keep informed. Read this article.

Curtiss-Wright's New Research Laboratory

38

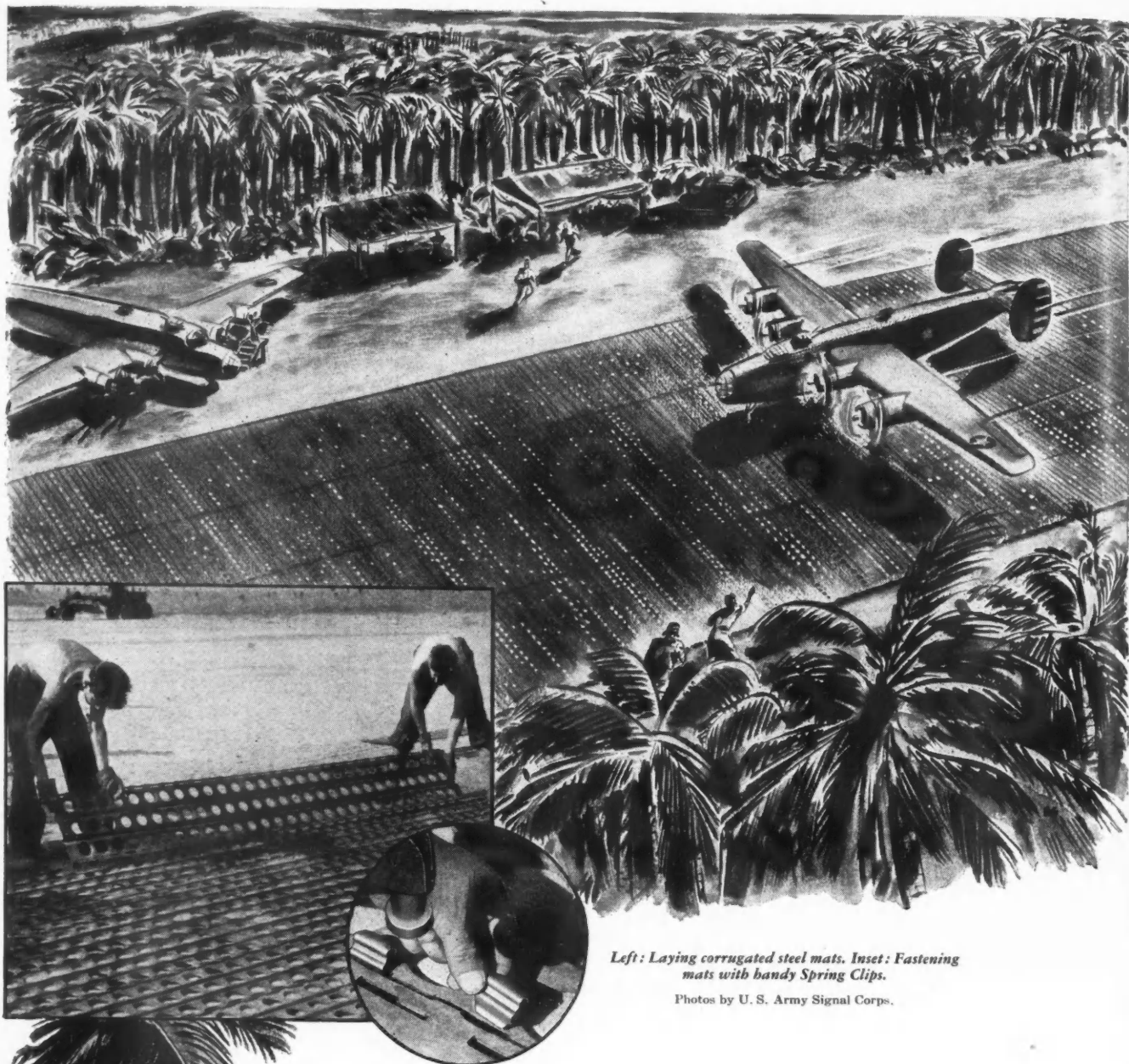
With its inception before Pearl Harbor, the new laboratory of this company has been pushed forward into its rightful place in the war effort. In some respects it differs from almost any other. Why and how it was all accomplished is told in text and drawings.

The Hawker Typhoon

41

This we believe is the first description and pictorial presentation of this most formidable of the British fighter planes.

15



Left: Laying corrugated steel mats. Inset: Fastening mats with handy Spring Clips.

Photos by U. S. Army Signal Corps.

SPRINGS FOR AIRPORTS— NEW GUINEA STYLE!

Recipe For A Portable Landing Field—Uproot trees, tear away undergrowth, plow earth level, lay steel mats, link together with Muehlhausen Spring Clips.

Portable landing fields are necessary so that airplanes may be the spearhead of attack. A necessity which does not allow much choice in location. A tangled jungle or a tide-swept beach must often serve. And, most important

— the runway must be laid with lightning speed.

The solution to this problem is the result of typical American ingenuity. Steel mats, not unlike enormous door mats, are laid in sections and connected with spring clips made by Muehlhausen. These tight-locking clips are serving admirably to absorb the tremendous shock and strain of heavy

bombers as they land and pull their weight to a sudden stop.

This unusual spring application is one of many ways in which Muehlhausen is contributing to our nation's war effort.

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SPRINGS

EVERY TYPE AND SIZE

Wanted—An Air Policy

By James R. Custer

Highlights of Postwar Aviation Program Endorsed by 18 U. S. Airline Companies

It is obvious and essential that the United States should have the shortest possible air routes to all countries of recognized or potential commercial importance.

A clear distinction must be maintained at all times between the right of innocent flight as distinguished from the right to engage in commerce by air.

Wherever adequate domestic service exists, foreign operations should not be permitted to pick up or discharge international traffic except at recognized ports of entry near our coasts or borders. Cabotage rights should not be sought by the United States if on a reciprocal basis.

The United States should seek all operating and commercial rights necessary to trade on equal basis with other countries, including the right of American flag carriers to maintain communication services, meteorological services, keep American personnel stationed in the territory of other states, and the like.

The United States Government should and must conduct many negotiations with foreign governments for the purpose of securing international air transport operating rights.

Subject to public convenience and necessity and consistent with the policies and standards established by the Civil Aeronautics Act, the policy should be established that any United States Air carrier may be permitted to engage both in domestic and foreign air transportation.

Government participation in the ownership or management of American flag carriers is undesirable.

Surplus military transport aircraft, capable of conversion for temporary peacetime use, should not be made available upon the cessation of hostilities for unrestricted sale or use which might adversely affect the development by the United States of its own domestic and foreign air transportation and national security.

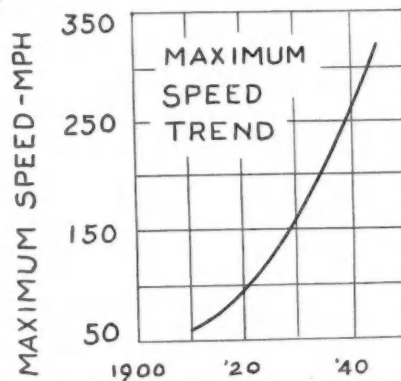
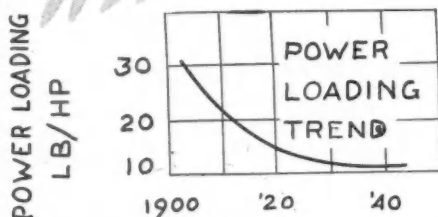
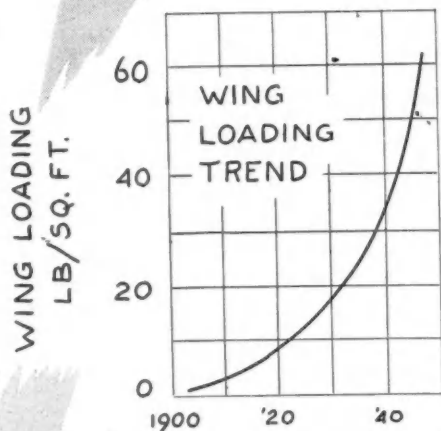
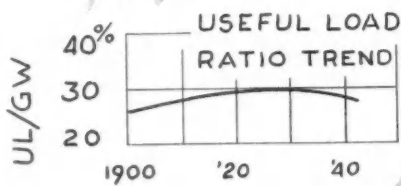
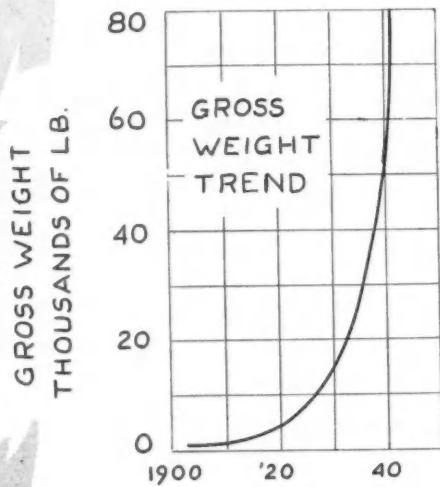
Subject always to the demands of the war effort and its efficient and successful prosecution, aircraft manufacturers should be authorized to prepare all plans and fabricate parts for the conversion of aircraft and to prepare plans for future civil and commercial aircraft . . . thereby effecting a more gradual and efficient conversion of their plants from a wartime to a peacetime production basis.

IF THE postwar problems confronting aviation companies in this country, both in the manufacturing and air transport fields, the greatest uncertainty results from the lack of any domestic and foreign air policies to enable them to plan for the transition period. The future for world-wide aviation is bright and especially for American aviation, which has much at stake in extensive manufacturing facilities, substantial domestic airline operations and a global system of airways developed by the Army and Navy, but its growth still depends upon a straightforward Government air policy devoid of political entanglements. What political and economic structures will exist in foreign countries and their attitude on air transport regulations further complicates the situation.

Realizing this need for a postwar aviation policy, the Civil Aeronautics Board early in May sent a set of questions on the subject to companies in the industry and other interested groups. A joint reply was received from 18 airline companies and the important points endorsed by them are listed on this page. The British Government has started to make plans to create a world system of airlines operated by the British Overseas Airways Corp. and a meeting with United States representatives is scheduled for next fall. Other countries also are beginning to study the problem.

In evaluating the future of American aviation there are several significant factors that must be taken into consideration. One is its present productive capacity. With hundreds of plants in operation throughout the nation, the products from them this year will reach a dollar volume of

Great strides have been made during recent years in the development of the airplane and in the trend charts on these pages is shown what progress has been made generally in major performance and design characteristics. These curves, which represent a corre-



\$20.1 billions, the War Production Board estimates. This figure makes the aviation industry America's No. 1 industrial giant with a plant capacity far greater than any other nation, particularly for transport planes. In addition it has resources of test equipment valued at millions of dollars and trained engineering staffs for research, design and production.

It is recognized that the present plant capacity is the result of a temporary military demand, but one that is not likely to disappear as it did after World War I. If air power means anything in the future, a modern air fleet will be necessary to maintain it just as sea power requires a powerful navy. Not only the domestic market will exist, but also a large foreign market for airline equipment as many of the smaller countries will lack the facilities to provide it for their operators. It is altogether possible that some phenomenal development in air transport will take place in foreign countries having only meager motor vehicle and railroad transportation facilities. In this country the situation is entirely different so that the airplane's part in extending transportation will be to develop new fields of travel and trade. Expansion of transoceanic and inter-country air routes offer worldwide opportunities for American airline companies.

In 1941 this country had 25,000 privately-owned airplanes and the airlines were operating 434 planes. Since Pearl Harbor most of the privately-owned planes and about 180 air-

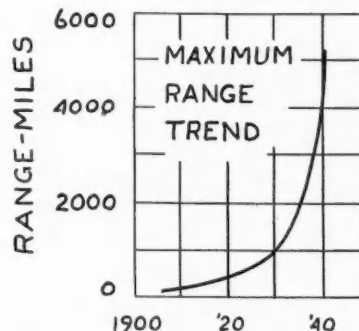
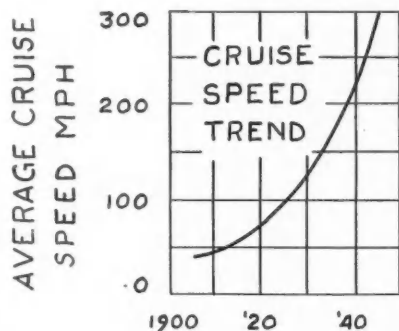
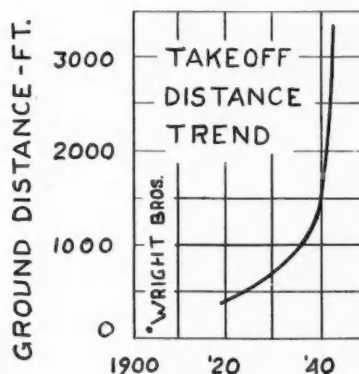
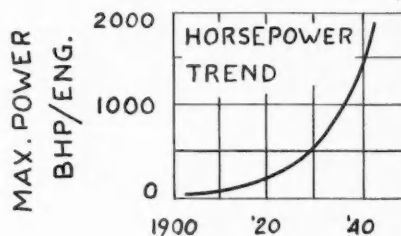
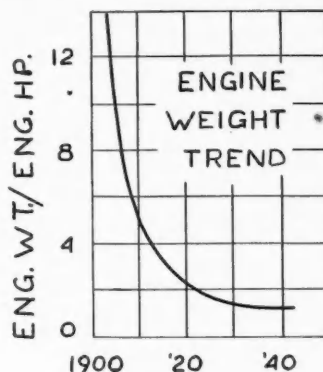
lation of scattered data, were presented at a recent meeting of the Society of Mechanical Engineers by W. W. Davies, United Air Lines research engineer, in a discussion of the past and the future of air transportation.

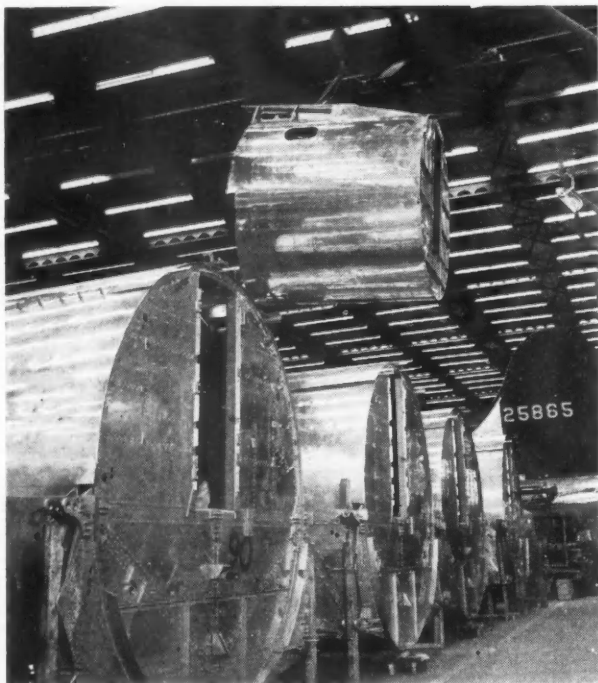
line ships have been converted to Government military service. Even with 42 per cent less flight equipment, the airlines are said to be carrying almost as many passengers and more express and mail than in 1941, when they transported 4,060,500 passengers, 44,595,300 pounds of mail and 22,315,000 pounds of express and freight. Quicker turn-arounds and more efficient maintenance have made this service possible with the result that the average daily mileage of a domestic airline plane was 1625 miles in March as compared to 1070 miles 15 months before then.

When the war ends there will be a large percentage of the 2½ million workers in the aviation industry air-minded as will be the 3,000,000 pilots, navigators, airport engineers and others trained by the armed services of this country. It should not be forgotten that millions of youths have been "sold" on aviation and are alert to its possibilities.

Today the United States has about 35,000 miles of civil airways, representing an increase of 5000 miles since 1941. In the military field the U. S. Air Transport Command has established 90,000 miles of air routes and the U. S. Naval Air Transport Service 50,000 miles. This network of airways is global in scope—to the Middle East, Australia, North Africa, India, British Isles, Hawaii and other Pacific islands, Latin America and Alaska. These routes have re-

(Turn to page 138, please)





Complete fuselage barrel assemblies are mated, after which line connections are made.

METHODS work at Vega Aircraft is now being conducted by a part of the regular operating organization—the Production Engineering Department. For several months recently, Mort Bach, works manager, and Bert Loyd, superintendent of manufacturing engineering, were at work on a plan designed to rapidly solve the problems arising out of the major operating difficulties that face individual foremen. An analysis showed that the more important difficulties faced by production foremen relate to:

1. Plant layout
2. Tooling (design, planning, simplification)
3. Parts disbursement
4. Conciliation of shop practice with engineering requirements
5. Customer change requirements.

It was found that in order to solve problems arising out of operating difficulties, the foreman quite frequently had to contact several different organizations. These organizations sometimes were located at such a distance from the department immedi-

The landing gear is installed on the center section before the latter is mated with the fuselage.

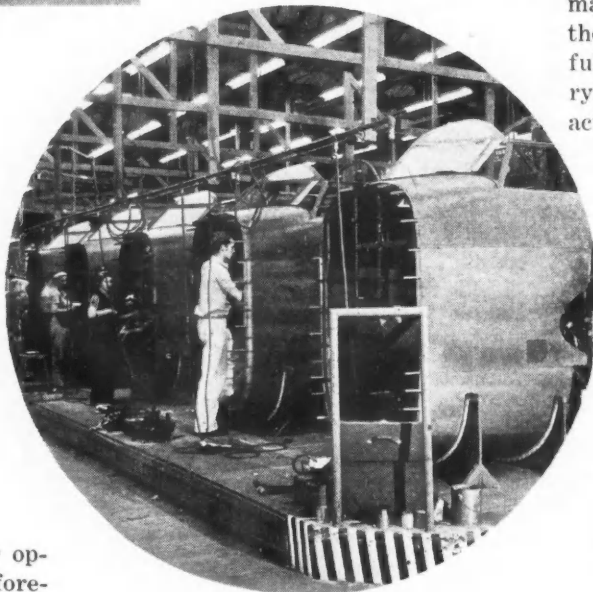
How Vega Engineering

ately concerned that it was impossible for the foreman to establish contact quickly and ensure rapid handling of the problem. It was, therefore, decided to establish an organization called Production Engineering that would have complete responsibility for the activities listed. It was also decided that this organization should be completely decentralized with respect to the shop departments.

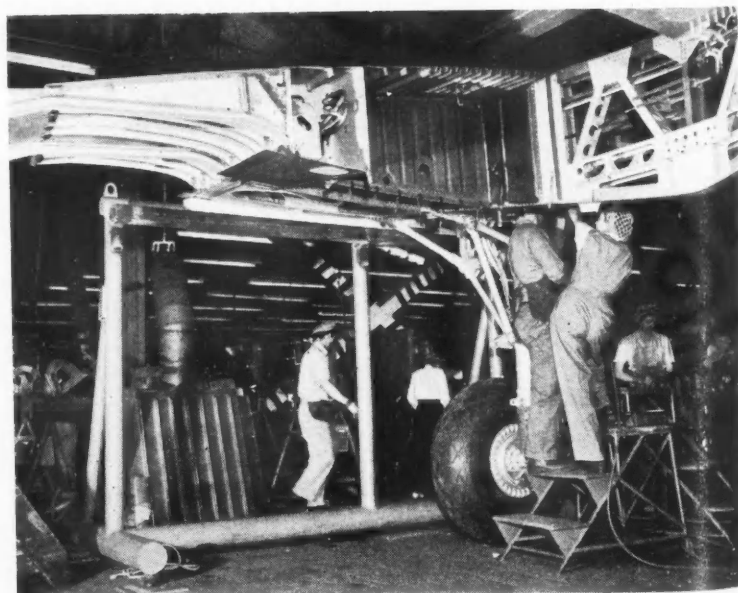
Thus in each production department a group of production engineers was placed adjacent to the fore-

man's office. Each of these groups was given full responsibility for carrying on the following activities within the particular foreman's department:

1. Planning of tools
2. Writing of tool orders for correction of tools to meet shop-practice requirements



The pilot's compartment is completed before it is assembled to the outer fuselage units.



Simplifies Production Methods

By Robert A. Trumpis,

Manager Vega Dept. No. 31

and Nels Irwin,

Vega Chief Production Engineer

3. Conciliation of shop-practice requirements with engineering callouts
4. Processing of all departmental work in coordination with the shop supervision to establish accurate disbursement of parts
5. Correction of work place arrangement to conform to departmental conditions such as limitations of personnel, area of department, schedule requirements, and material flow
6. Establishment of smooth material flow and elimination of backtracking
7. Establishment of measured and balanced work stations, including personnel requirements
8. Establishment of ship serial numbers at which changes could be installed commensurate with the schedule requirements.

The organization developed comprises a chief production engineer, section engineers who cover broad areas and several models, and group engineers who are assigned to specific departments. The production engineering organization is directly under the manager of manufacturing planning, who also has charge of the following departments:

1. New Development, which is responsible for planning, change research and preliminary construction prior to planned production manufacture
2. Disbursement-records control.

With operating responsibilities thus assigned, it becomes possible for the production engineering organization to work expeditiously on the problems of the shop and to secure the information necessary for the quick analysis and elimination of operating difficulties.

By trial-and-error methods it was established at Vega and Lockheed that aircraft manufacturing problems cannot be solved quickly enough by survey and recommendation of industrial engineers or methods men who are not affiliated with the operating plant. With a separate methods group, standardization is impossible, because there is no connection between this industrial organization and the operating organization, and no operating-responsibility tie-up. With the new

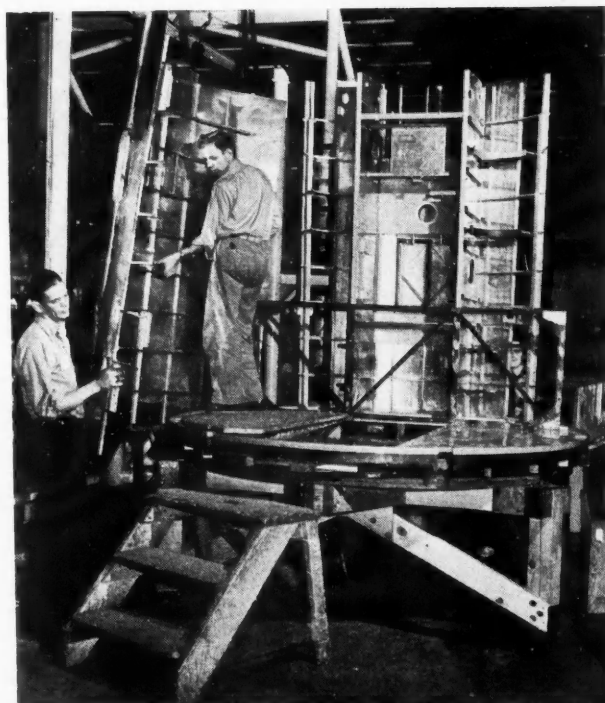
organization, every improvement developed is immediately carried through in every other department in which similar problems arise. In this way any improvement in production procedure automatically benefits the entire plant.

Production models at present are undergoing a revised break-down to make it possible to completely preassemble such units prior to the mating operation. This method reduces the final assembly line to a very few stations and permits full utilization of the available floor space. Assembly operations in the pilot's compartment are carried on without the obstruction of the frames and skins and other structural members of the fuselage. The control column, all brackets and controls, and the control stand are installed before the completed side and cab panels are added to complete the unit. Under this system, accessibility alone has accounted for the saving of many man-hours.

Preinstallation of the landing gear in the sub-assembly stage also makes possible the completion of the hydraulic system and much of the electrical and plumbing installations before mating the center section with the fuselage.

To further simplify assembling operations, stock racks are provided next to the assembly jigs, which

(Turn to page 94, please)



Complete panels are mated to form fuselage "barrels", thus eliminating "skinning" operations on the floor. Note that no jig is required.

Absenteeism Under

MAKING the plant more than just a place to work has helped the Vultee Field Division of Consolidated Vultee Aircraft Corp. achieve a remarkably low absentee rate. An active Employee Service Department, a busy post office and a well-stocked general store are outstanding features of a plan of cooperation designed to free workers of necessity for taking time out to attend to details connected with living.

Evidence of the success of the plan is an absentee

rate of only 3.3 per cent during the last six months. Breakdowns on the causes of absences show that illness is the largest single factor, other reasons having been eliminated by inauguration of plant services which run an interesting gamut from vitamin pills sold at cost to aid in obtaining fishing and hunting licenses.

Prior to inauguration of these services employees gave as their reasons for a large portion of absenteeism necessity for days and half days away from their jobs to take care of such personal businesses as getting legal papers notarized, obtaining voting certificates, paying utilities or going to the store. Vultee Field Division decided that to do away with such reasons its employee service experts must create at the plant places where most of these needs could be satisfied.

First of the three features in importance is the Employee Service Department itself.

Four men and a dozen women handle problems here which otherwise would rob the plant of hundreds of man-hours every week, with employees taking time out to attend to them and which also would result in further time lost through a higher rate of terminations on the part of discouraged debtors. Bills of the employees are paid by this office, garnishments are handled here so that entire pay checks are not attached, traffic fines are paid, often settled without payment of fines, jury duty calls are straightened out for employees, tax returns are made easy through expert assistance, hunting and fishing licenses are obtained, passports are made obtainable for those who would fish off the coast on days off or enjoy boat rides where permissible. A new feature will be the payment through this office by its personnel of light, phone and gas bills of employees so that they need not take time to attend to them if they do not have checking accounts.

Plans are being completed also



(Upper Left) One of the myriad functions of the Vultee Employee Service Department—the selling of vitamin tablets at cost to employees. At other windows, traffic violations are attended to and fishing licenses issued, while at others, bills are paid including home utilities, and garnishments are avoided among other services.

(Left) The Vultarian Store's priority number enables it to obtain every type of tool needed by employees. It is the only aircraft plant store with the coveted priority number.

Control at Vultee

By Adrian R. Baish

Supervisor of Employee Service, Vultee Field Div.,
Consolidated Vultee Aircraft Corp.

by this office for summer camps for the 9 to 15-year-old children of employees during summer vacation months, in a move to combat delinquency and free parents from the necessity of laying off work to take care of the idle children at home. Many women will take time off to watch over their children while school is out, the service experts reason, if such camps are not available. The service office is enlisting the cooperation of the Forest Service and recreation boards of Los Angeles city and county, in preparing the camps.

When this office receives a credit letter from a collection agency or store or physician asking if a certain employee is with the company that employee is called in to the office and questioned about his debts.

Invariably he will deny owing anything, so Employee Service's next move is to answer the letter and ask for details. When a reply giving the details is received, the employee again is called in, and with both sides of the story available to them, the service people go to work. They convince the employee that he is stuck for the bill, regardless of how he feels about it, that it will be taken out of his entire check if he doesn't let the service office handle it for him. Usually, he capitulates and a small amount is taken from his check each week and sent to the creditors.

Employees receiving traffic violation tickets turn them over to the office, which communicates with the court to which he is to report. Sometimes through such intercession fines are reduced to negligible sums or waived altogether, and what is to be paid is paid by the office which collects from the employee so that he needs take no time off.

The office regularly posts Automobile Club information on where hunting or fishing is good, and an employee seeking such relaxation at regular vacation

AN outstanding accomplishment in overcoming unnecessary absenteeism is the record of the Vultee Field Division aircraft plant, which has reduced its overall absentee rate to 3.3 per cent of the workers. A recent survey of 25 war plants by the National Association of Manufacturers disclosed they have an average absentee rate of 5.42 per cent as compared to 3.48 per cent prior to the war.

In April leading executives of the country's aviation companies toured the Pacific Coast aircraft manufacturing plants to make a first hand study of the most successful projects at each one. They visited Vultee to investigate that company's method of controlling absenteeism. In this article the author describes the various methods that are achieving that purpose at Vultee.

times need only to pay for his license at the office during his lunch period or after work and it is obtained for him.

The Coast Guard sent a crew of eight men to the



Everything from hairpins to home furnishings can be purchased at the Vultee store.



The Vultee Post Office provides all the services of a Government post office. Supervisor Taz Ezell is shown making a stamp sale.

have to take time out to obtain their own priority numbers for the purchase of tools and then shop around until they found them. They must furnish their own tools with the exception of drill bits, files, hacksaw blades and special tools used occasionally. Through its priority, the store being the only one in the aircraft industry operating under PD 1-X, it can supply all types of tools and even electrical refrigeration, which it sells along with complete outfits furnishing homes, even to over-stuffed furniture.

Six people clerk in the store during rush hours. In addition to all kinds of men's furnishings the store carries women's sport suits, lingerie, work slacks, hose, shoes, watches and cosmetics. Even framed pictures are on sale, and auto accessories, the entire stock being chosen only with a view to cutting down employees' reasons for taking time off to shop. In addition, the store handles shoe repairing and laundry and offers to pay insurance bills and the like.

The 3-cent stamps sold by the Vultee Field Division post office, unique in the aircraft industry, totaled \$27,103 in 1942, a total of 900,000 of these stamps having been sold. Its receipts make this contract post office

the equivalent of second-class post offices operated by
(Turn to page 74, please)

Breakdown of Reasons for Absenteeism for March, 1943 At Vultee Field Division Plant

Reasons for Absence	Per cent of Total Absentees
Illness of Employee	80.8
Illness or Death in Family....	8.1
Transportation Difficulties	
Car Trouble8
Driver	1.5
Other	1.3
Auto Accidents6
Military Reasons5
Employees Needing Care for Children6
Legal7
Moving4
Miscellaneous	4.7
Total Reports	100.0

plant at the behest of the service people, when requests were made by employes for passports for fishing and boating along the coast. The office obtained all the necessary data, including photographs and birth certificates from personnel and identification files, and the granting of the passports was simple and required no time off.

Hundreds of women will be held to their jobs through the summer camp plan. More than 1000 boxes of vitamins are sold at cost to the employes by this office every month, resulting in better physical condition and thus cutting down absenteeism from sickness.

The Vultarian Store, employee-operated and profits from which go to finance employee activities such as baseball, basketball and picnics, carries everything from welders' goggles to fishing tackle, and from cosmetics to baseball equipment. Its stock consists of tools valued at \$27,000 and other merchandise with a value of more than \$7000, exclusive of a jewelry concession. In 1942 the store got out of the red, paid off notes amounting to \$6700 and made a profit of \$6900.

Without the store, employes would

A jewelry and watch repairing concession enables employes to buy things they could not obtain outside, and saves them time, making it possible for them to turn watches in for repairs during lunch hour and while enroute into and out of the plant.



Development

of A Light Weight Diesel Engine

for the Navy

By J. C. Feters

Electro-Motive Div., General Motors Corp.

THE story of how the development of the General Motors Model 16-184-A engine started and finally resulted in a light weight marine Diesel engine weighing only 4 lb per hp is almost as interesting as the mechanical details of the engine itself. It was only a matter of some two months after Pearl Harbor that these engines began to roll out of the new plant set up for their manufacture at the Electro-Motive Division of General Motors at La Grange, Ill. Back of this accomplishment of fact was over five years of intensive development by the Navy and by Industry, as represented in this case by General Motors.

During the year of 1937, representatives from the Diesel Engine Section of the Bureau of Ships, Navy Department, came to the Research Laboratory of General Motors at Detroit to discuss the possibilities of developing a light weight diesel engine for marine propulsion for certain applications where weight and space were at a premium. Various diesel developments were being carried on in the laboratories at that time, among which was a single cylinder project which had been started to investigate the possibilities of an aircraft diesel engine. This single cylinder project had as its objective the development of a cylinder and piston construction of very light weight, and an output of 75 hp in one cylinder. From a discussion with the Bureau of Ships representatives, it appeared that a 16-cylinder engine would approximate their power requirements, but they pointed out that a V-type arrangement of such an engine would be too long and too heavy for their intended application.

After examining numerous engine arrangements, it was decided that a 16-cylinder, 4-bank radial engine offered the best chance of attaining the minimum space and weight to suit the Navy requirements. Since a gear reduction to the propeller shaft was necessary, and since length and weight of engine foundation were of importance, it was decided that the most economical arrangement would be to place the engine in a vertical position on top of its gear box, and to obtain

the reduction through a pinion and ring gear in a right angle drive.

One of the chief problems was that of the connecting rod construction. Of the various types which are normally used, such as side by side, fork and blade, articulated, etc., all would have made the engine larger and heavier than the slipper type chosen. With this construction there are four connecting rods bearing directly against each crankpin, but due to the articulation, the arc which could be subtended by each rod pad was only 66 deg. and this resulted in a very high loading. It was necessary to make a special test machine in order to develop this bearing construction to the point where it had sufficient life.

Since the engine was of the two-cycle type, it was necessary to have an engine driven blower. The various types of positive displacement blowers were far too bulky and heavy and it was decided that a centrifugal blower offered the best chance of fulfilling the minimum space and weight requirements. To check the performance of such a blower, the design of the one intended for the multi-cylinder engine was completed in advance of the engine and the blower was built and tested.

Considerations of light weight consistent with a high degree of fatigue resistance dictated the selection of a welded, alloy steel type crankcase. Due to the thin sections required to keep the weight down, fabrication of such a structure was quite a problem, and to gain some needed experience, an experimental case was built consisting of half of the proposed 16-cylinder structure. This was set up in a special fixture and subjected to a dynamic load test simulating actual firing pressure stresses in the engine. Somewhat the same procedure as the foregoing was followed for all the other sub-assemblies required.

This first 16-cylinder engine made its initial run in June of 1939. It took another year of intensive development before the engine was able to pass the 168-hour endurance test proposed by the Navy. There then followed a redesign and a program for constructing a pair of engines for an actual boat installation. This work carried through 1940 and 1941, the experimental boat being finally accepted and commissioned by the Navy in August, 1941. Concurrent with the experimental boat program, plans were made to set up a plant for production of these engines in limited quantities, this phase taking place during 1941.

(Turn to page 70, please)

This article is an abstract of a paper presented by Mr. Feters June 3, 1943 at the SAE Diesel Engine and Fuels & Lubricants Meeting in Cleveland.

The de Havilland



Wing assembly shop at one of the hundreds of British plants where Mosquito components are made and complete aircraft assembled. (Courtesy "The Aeroplane", London)

DETAILS of the constructional features of the de Havilland Mosquito fighter and bomber, one of the outstanding developments in aircraft design during the war, have been released for publication. First mention of the existence of this unique machine was permitted a few months back, when several of the bomber type, without escort, bombed the Nazi headquarters in Oslo, Norway, and soon after made two daylight raids on Berlin.

The Mosquito is claimed to be unique in several respects. Thus, although the maximum speed of even the earliest operational version may not be specified, it is stated without qualification to be the fastest aircraft now in operation in the world. A world's record is claimed, too, in the time taken (only 22 months) to carry it from the first stage of design into operation against the enemy. It is also said to have the most widely dispersed production of any aircraft. Then, it is not only a long-range fighter of higher speed than any fighter now in enemy service, but also a bomber that has no need for a fighter escort, owing to its being able to outdistance

This fighter-bomber of wood construction, claimed to be world's fastest military aircraft, now being built in Britain and Canada. Packard-built Rolls-Royce Merlin engines and Hamilton propellers installed on Canadian planes.

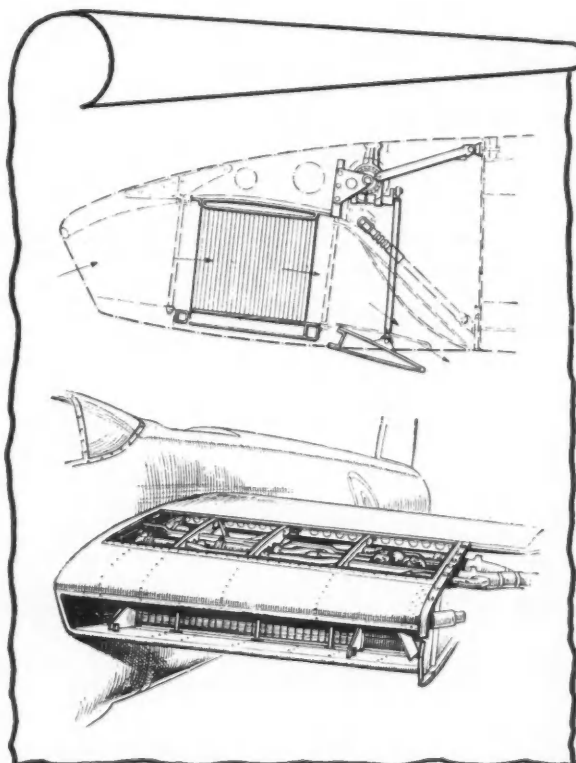
the fighting planes of the enemy.

From the constructional viewpoint it is unique among modern military aircraft in being built almost entirely of wood. There were three reasons why a wooden construction was chosen by its designers, viz., (a) to get more quickly through design and prototype stages and into production,

owing to the urgency of the times, (b) to tap new sources of material supplies, and (c) to employ a fresh labor group. Other advantages in mind were greater buoyancy and ease of repair, and the fact that

a wooden construction lends itself remarkably to dispersed production. In the latter connection it may be said that furniture and other wood-working plants by the hundred, large and small, have been turned over to Mosquito production.

In Britain alone the de Havilland Aircraft Co. has literally scores of

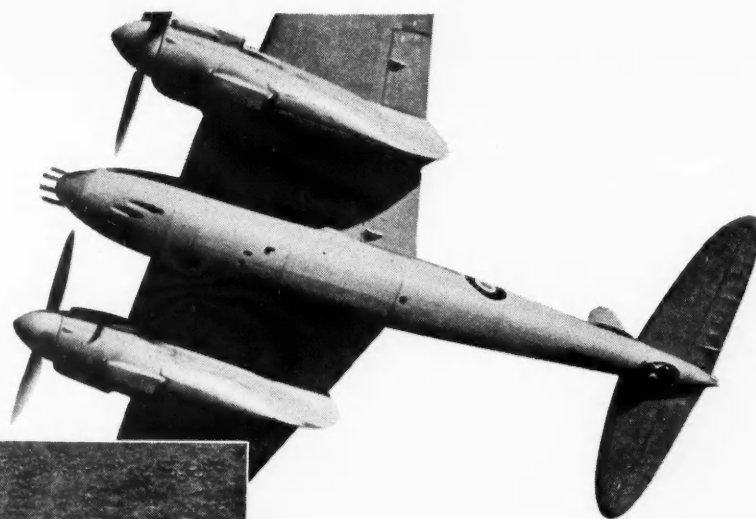


Above, section through leading edge of wing enclosing radiators and air flow control. Below, front view of wing radiators for oil, coolant and cabin heating. (Courtesy, "Flight", London)

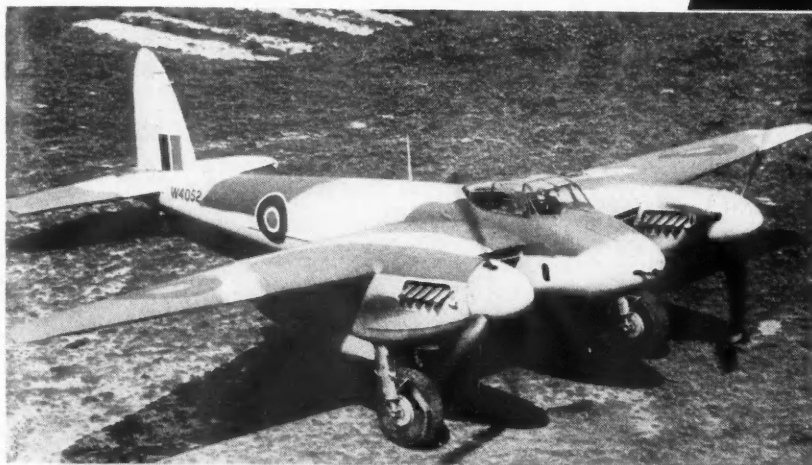
Mosquito

By M. W. Bourdon

Special Correspondent of Automotive and Aviation Industries in Great Britain.



*The fighter version of the Mosquito.
(de Havilland photo)*

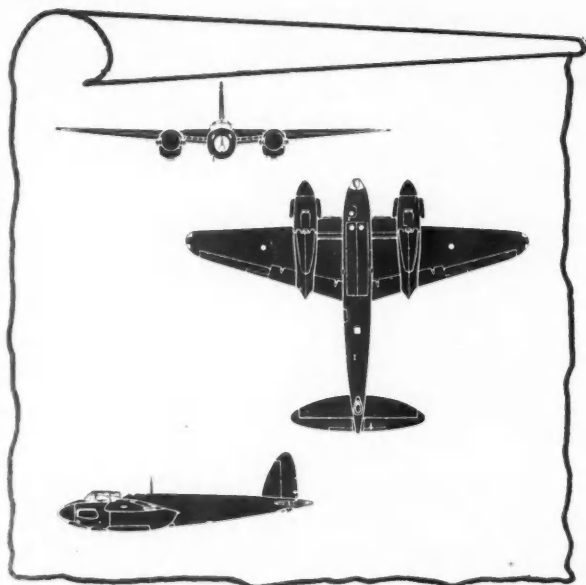


pellers are of the type developed by the Hamilton Standard Propellers Co.

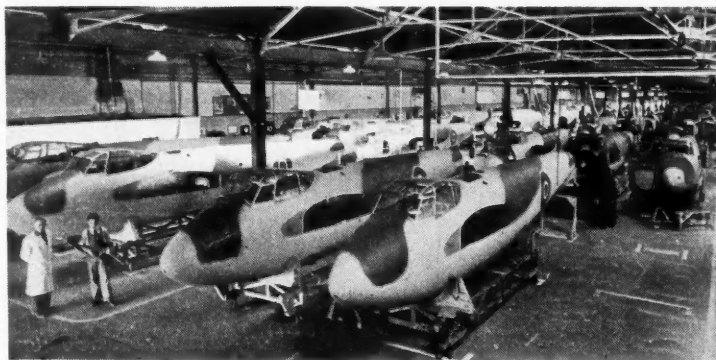
The plywood stressed skin fuselage is similar to that of the D. H. Albatross of 1937 (still in operation by the British Naval Air Arm), so the weathering durability of the wood in European, Arctic and tropical climates

is well known from experience. A point worthy of remark is that to create a wooden airframe with the same strength factors as a metal airframe obviously necessitates more bulk in the spars and other members. As a result, bullet and flak holes represent a smaller percentage of the mass of any member they may pierce, which has proved to be a practical advantage under war conditions. Repairs are easily effected by carpenters of average skill. As to buoyancy, Mosquitoes have floated many hours after being brought down into the sea.

Another outstanding feature of the fuselage is that the "shell" is divided longitudinally from nose to tail, top and bottom. Turn to page 30, please. On the next two pages are detailed drawings of the de Havilland Bomber.



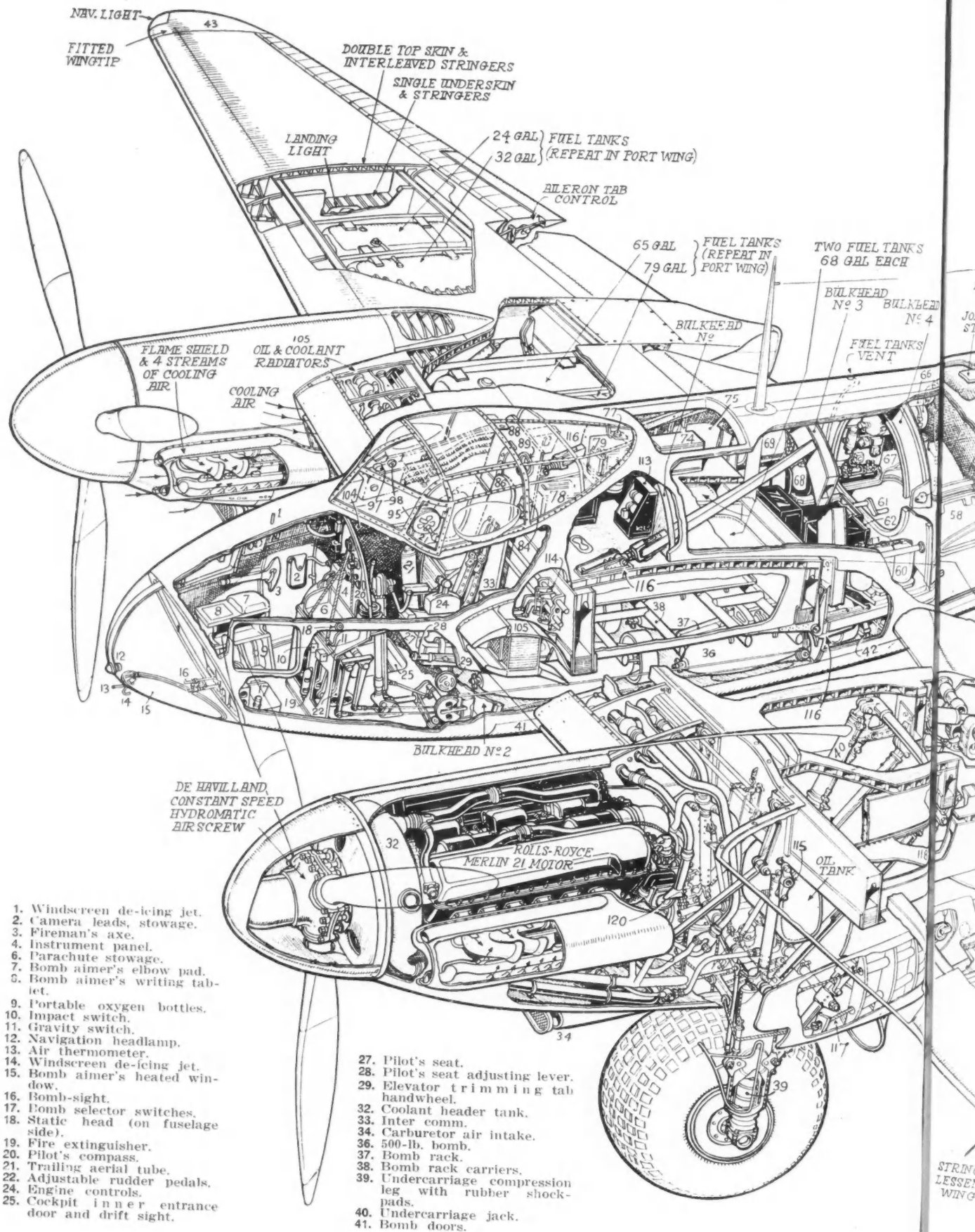
Courtesy "The Aeroplane", London



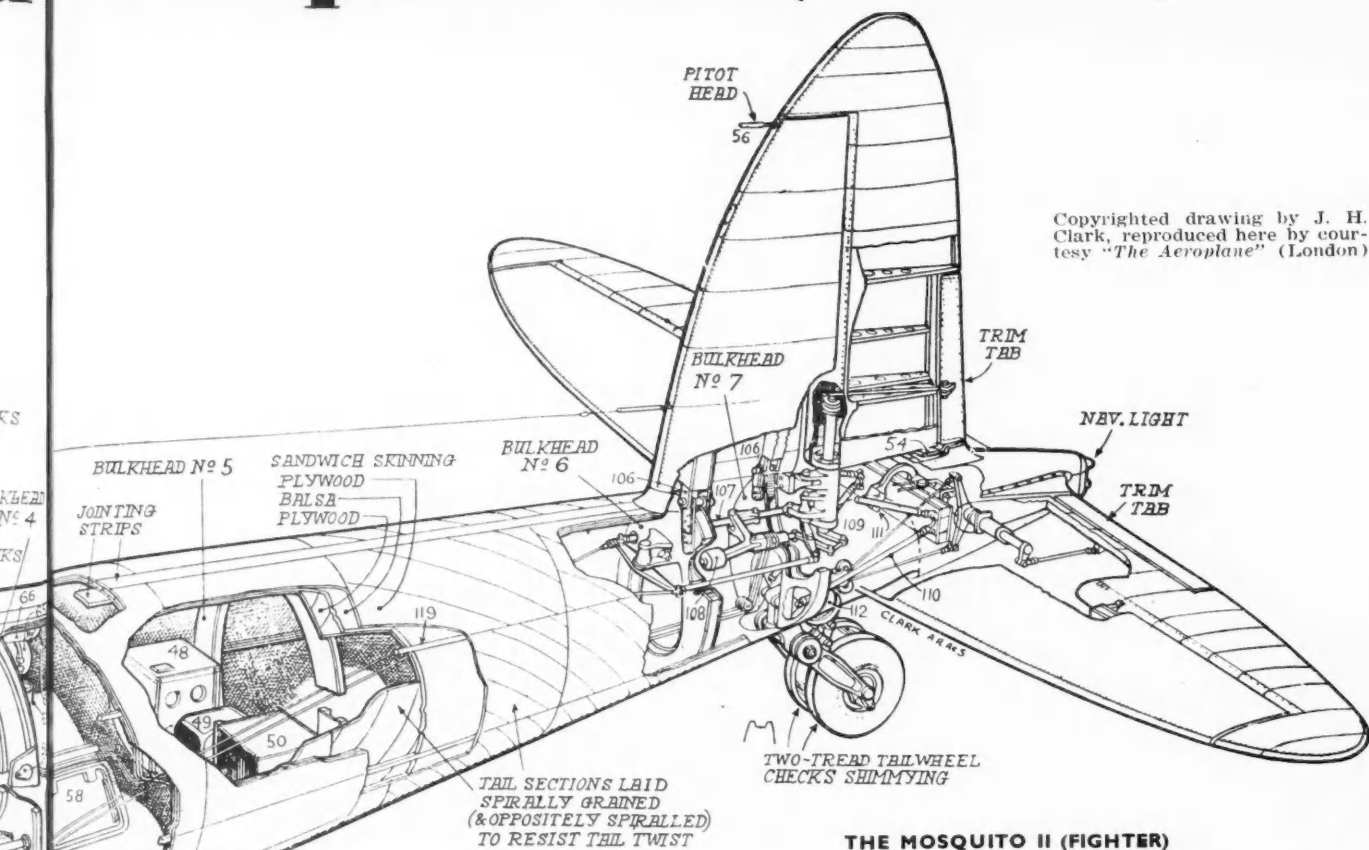
Fuselage assembly lines at one of the many plants in Britain where de Havilland Mosquito fighters and bombers are produced. (Courtesy "The Aeroplane", London)

dispersed depots and plants, and some 400 sub-contractors are making components. A similar situation prevails in Canada, where the Mosquito is also in production. The United States has its share, for the Rolls Royce Merlin 21 engines in the Canadian-built Mosquitoes are of Packard manufacture, and the full-feathering constant-speed pro-

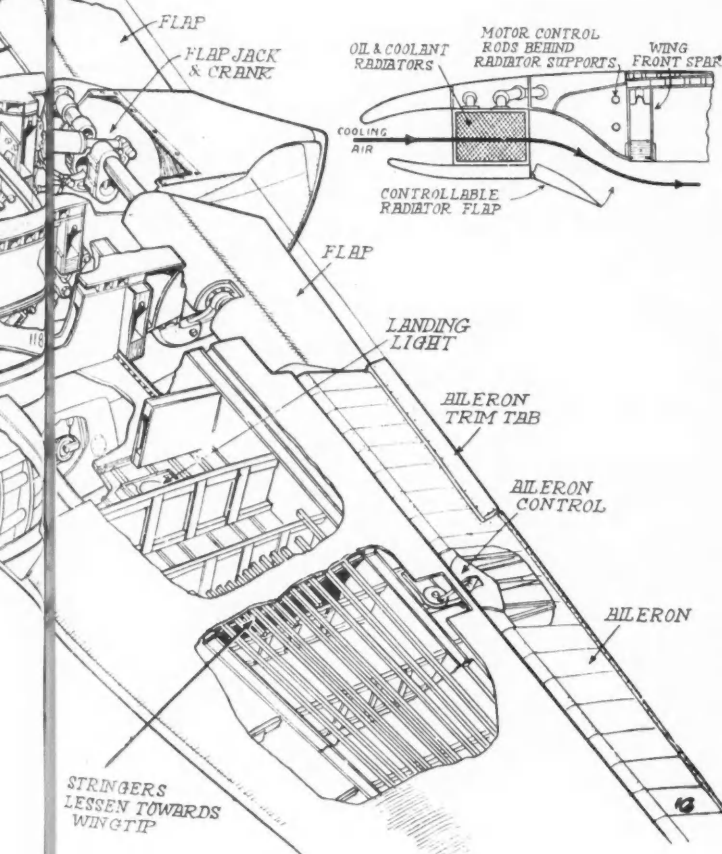
The deHavilland



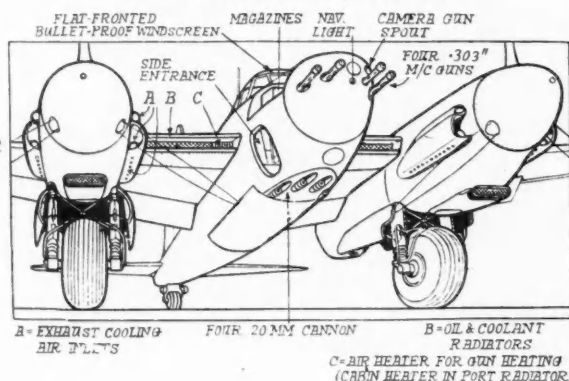
Mosquito IV (Bomber)



Copyrighted drawing by J. H. Clark, reproduced here by courtesy "The Aeroplane" (London)

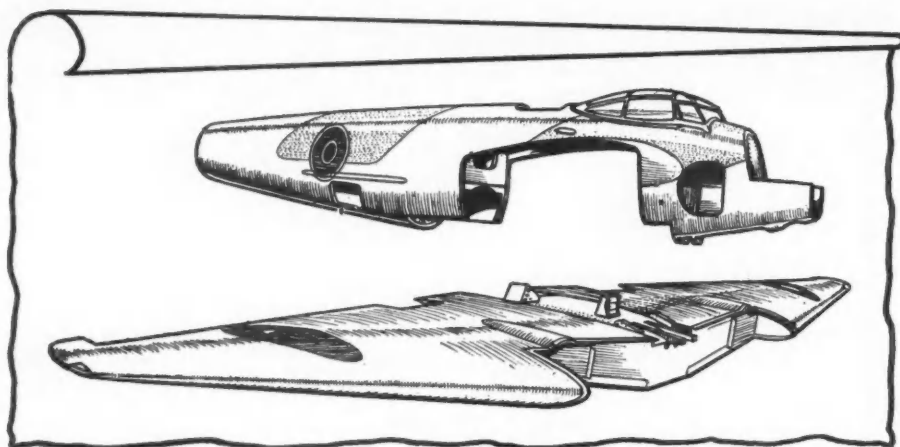


THE MOSQUITO II (FIGHTER)



- 42. Bomb-door jack.
- 43. Detachable wing tip.
- 48. Stowage for camera, heating cables.
- 49. Rear camera, F24.
- 50. Camera mounting boxes.
- 54. Tab mass balance.
- 56. Pressure head.
- 58. Rear entrance door.
- 59. Ground starter plug.
- 60. Oxygen bottles.
- 61. Bomb winch.
- 62. Accumulators.
- 63. Aneroid switch (super-charger).
- 64. Cabin lamp.
- 65. Compressed-air container.
- 66. De-icing fluid tank.
- 67. Pneumatic hydraulic panel.
- 68. Oxygen bottles.
- 69. Hydraulic reservoir.
- 74. H.T. power unit.
- 75. Dinghy stowage.
- 77. Upward identification lamp.
- 78. Receiver type R1155.
- 79. Transmitter type T11548.
- 84. Fuel cock controls, pressure-venting control.

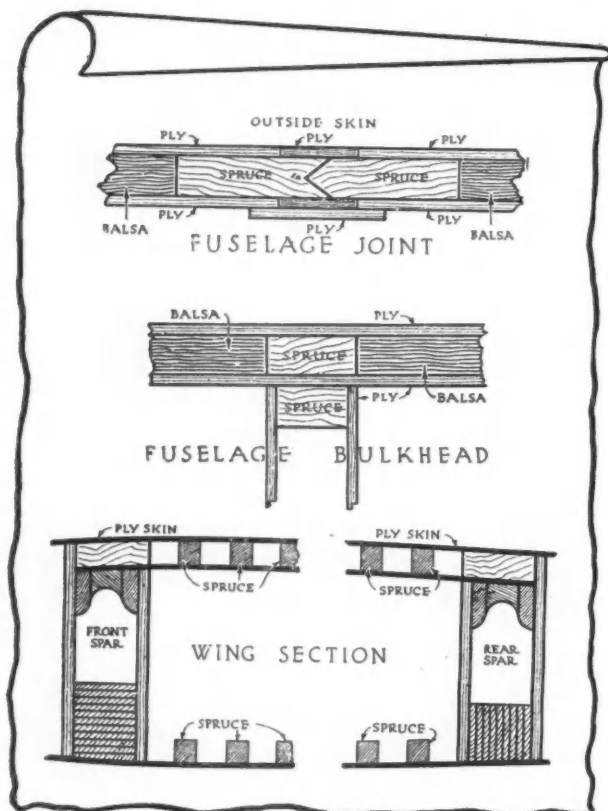
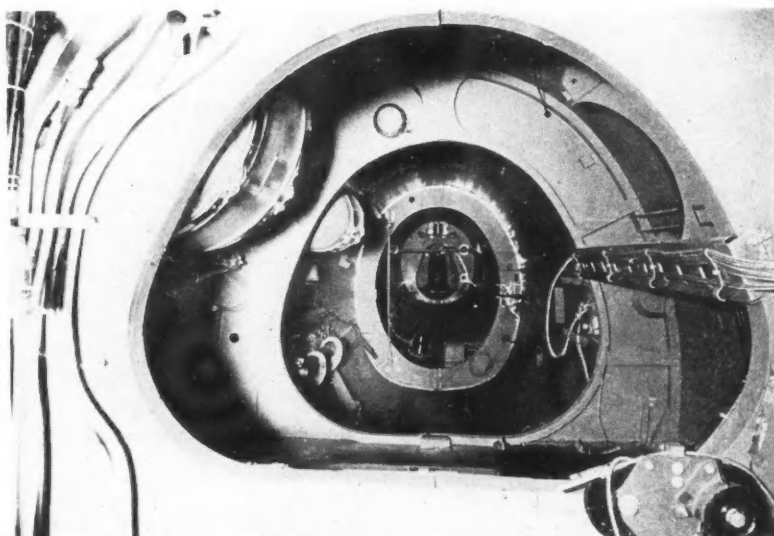
- 86. Pilot's armor.
- 88. Observer's armor.
- 89. Observer's window.
- 95. Hinged window.
- 97. Signalling switch (formation keeping).
- 98. Signalling switch (identification).
- 104. Navigation table.
- 105. Oil and coolant radiators.
- 106. Fin fixings.
- 107. Rudder control spring-loaded rod.
- 108. Rudder mass balance.
- 109. Rudder linkage.
- 110. Support rods for rear spar of tailplane.
- 111. Elevator mass balance.
- 112. Operating jack for retracting tailwheel.
- 113. Voltage regulator.
- 114. Throttle and airscrew control rods.
- 115. Lug for jacking undercarriage.
- 116. Wing fixing.
- 117. Elastic cable for undercarriage door.
- 118. Inspection doors to fuel tank bays.
- 119. Four longerons between ply skin.
- 120. Magneto heating.



Sketch showing how the fuselage and wing are brought together as separate units in process of assembly. (Courtesy, "Flight", London)

Looking aft through the fuselage of a Mosquito from the third bulkhead from the front. The hydraulic tank is behind the bulkhead on the left, with oxygen bottles in the next division. (Courtesy "The Aeroplane", London)

bottom, which, among other advantages, facilitates the installation of electrical and other equipment. Then, it has a compression-rubber type of undercarriage leg, which can be made by any ordinary sub-contractor and which eliminates large forgings and the use of big machine tools; it has no high-precision tubing, pistons or valves and is made to tolerances of hundredths instead of thousandths. Throughout the airframe the use of machined parts, forgings, Dural extrusions and light alloys generally has been minimized. Forgings, indeed, are almost non-existent, high-strength castings being used instead.

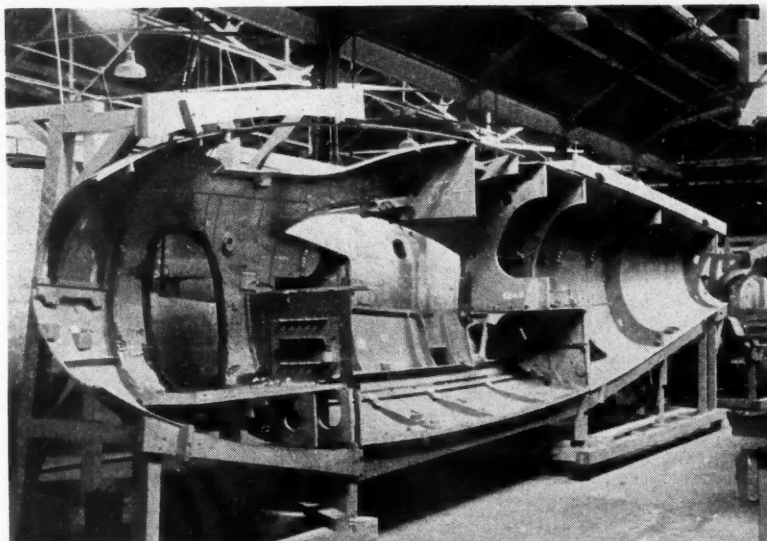


At the time of writing there are four basic mark numbers of the DH 98, as the Mosquito is termed in the makers list of types. All four versions, including Mark I (prototype) and Mark III (standard dual trainer) have two Rolls Royce Merlin 21 engines and two seats. The prototype was given a wing span of 52 ft 6 in. but this has been increased to 54 ft 2 in. in the later versions and the engine nacelles increased in length. The fighter (Mark II) is armed with four 20 mm cannon and four 0.303 in. machine guns. The bomber (Mark IV) is unarmed and carries a bomb load of 2000 lb stowed internally.

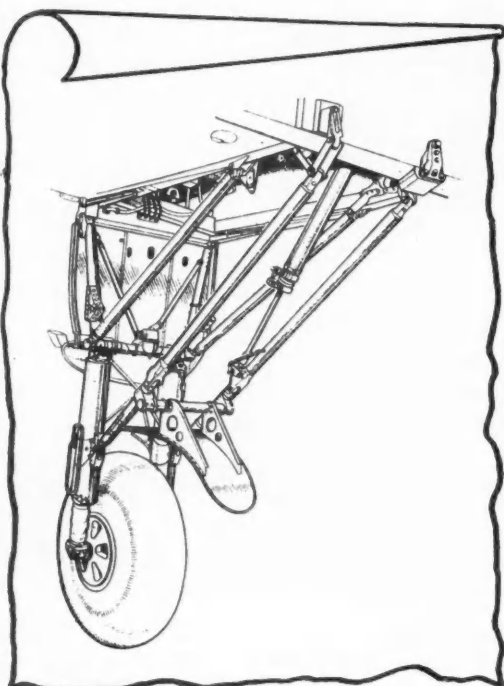
Aerodynamically, the Mosquito is a high mid-wing monoplane with fully retractable undercarriage and a single fin and rudder. The radiators are located within the center section of the wing, between the engine nacelles and the fuselage, where they give rise to remarkably little drag. The only excrescencies of the nacelles are the forward-facing air intakes underneath and the flame traps of the exhaust. The wheels

Sectional diagrams showing methods of building up the wooden fuselage and wing. (Courtesy, "The Aeroplane", London)

Starboard half of the fuselage of a Mosquito; it is identifiable as a section of the fighter type by the door at the side of the pilot's cabin. The bomber version has an entry hatch in the floor. (Courtesy "The Aeroplane", London)



The Mosquito undercarriage units are identical and interchangeable. Springing is by piles of rubber blocks working in compression. (Courtesy "Flight", London)



retract rearward into the engine nacelles. A small portion of the tail wheel projects when retracted. On the fuselage the only excrescence is a small roof above the cockpit. There are no gun turrets. All guns of the fighter fire forward; the machine guns project from the point of the nose, while the four cannons are entirely within the belly.

Inner and outer skin of the wooden shell are of plywood with a sandwich layer of balsa wood, the purpose of which is to stabilize the relatively thin plywood skin. The longitudinal halves of the fuselage for each machine are built at the same time so that temperature variations affect both halves equally. They stay together throughout assembly until join-

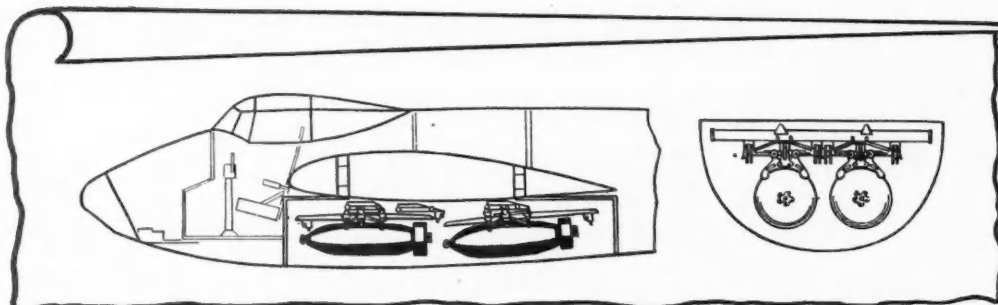
ed finally and are not interchangeable. All equipment, electric leads, etc., are installed before the halves are joined. Port and starboard sections are scarfed together with V-grooving in spruce inserts; a plywood strip is fitted on the joint inside and a ply insert outside.

At the points where the seven bulkheads are attached the balsa core of the skin layers is omitted and a spruce ring substituted. Each bulkhead is built up of two plywood skins kept apart by spruce blocks. The skin varies in thickness from 1.5 mm to 3.0 mm. Wherever the skin is highly stressed the plywood is wrapped on diagonally; elsewhere it is put on straight, as this uses less wood. No attachments are made directly to the skin. Instead, a hole is drilled from the inside through the ply to the balsa, and a bakelite plug with a ply flange is set in the hole and glued there.

Wings are built in a single section from tip to tip. The center section carries the radiators and engine mountings. The fuselage drops on top of the center section and is secured by four massive pick-up points. The latter are of laminated spruce glued to spruce inserts in the skin and afford a very large bearing area for the distribution of the load. There are two box spars with ply webs and laminated spruce flanges. The front spar has three laminations on top and eleven at the bottom, while the rear spar has three and nine respectively. The skin passes right across the top and

(Turn to page 89, please)

Side and front elevations of the bomb bay in the Mosquito bomber. Racks with 500-lb bombs are shown. (Courtesy "Flight", London)



GEARS and gear assemblies for the Studebaker-Wright Cyclone nine-cylinder airplane engine are produced in a self-contained plant, constituting one of the plants of The Studebaker Corp., airplane division. The general setup of the plants of this giant operation was described in *AUTOMOTIVE AND AVIATION INDUSTRIES*, April 1, 1943.

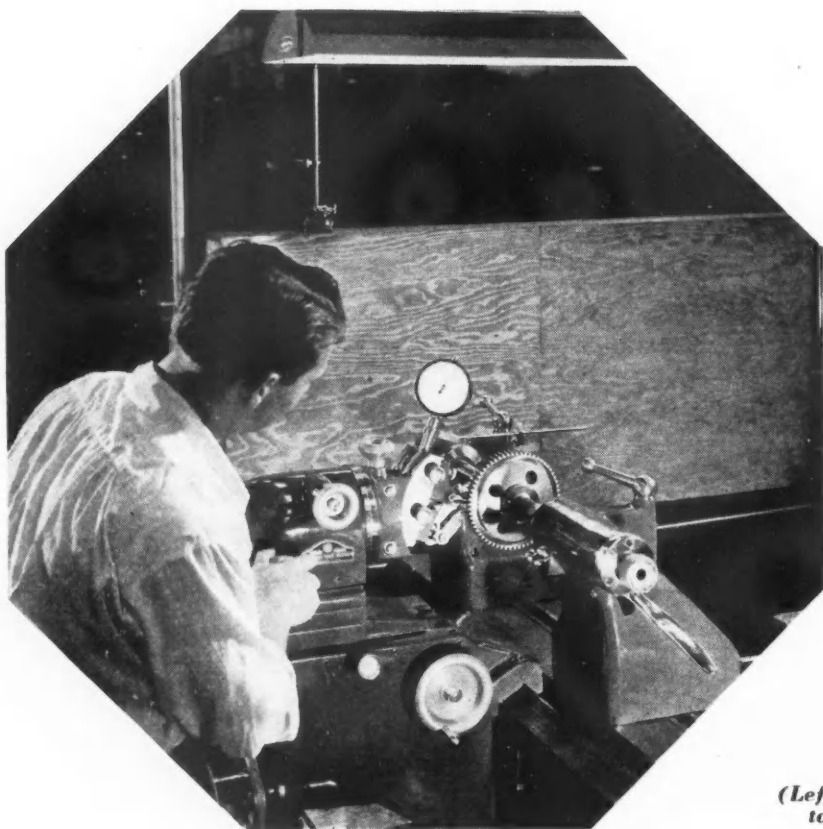
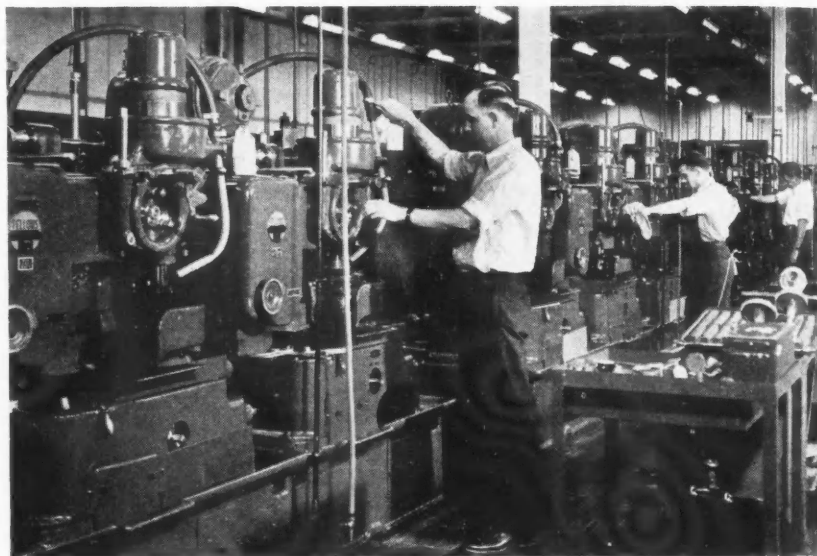
Generally speaking, in setting up this gear plant, Studebaker followed Wright designs and the pattern of Wright manufacturing methods. This constituted the starting point for the selection of production machinery, for the establishment of production routings, and the planning of the plant layout. From this point on, Studebaker engineers have maintained close contact with the Wright organization in a mutual exchange of improvements in methods by virtue of production experience gained by them.

At the present writing, Studebaker is producing 63 gears and assemblies for the Wright Cyclone engine. Like

the other plants in the Studebaker group, this one is housed in a modern single-story windowless black-out type building, with parquet floors. It has been conceived as a self-contained operation designed to produce finished gears and assemblies right from the raw materials received from outside forging shops.

An interesting commentary on the gear plant is the fact that the management was forced to start from scratch with new supervision and practically green

(Right) View in gear cutting department showing one of the long rows of Fellows gear shapers.



Sixty-three

By
Joseph
Geschelin

(Bottom of facing page) Part of a large battery of 4L Gisholt turret lathes, fitted with Carboloy-tipped tools, is used for rough machining and finish machining operations on the big Nitralloy bull ring forging.

(Left) In the gear lab—checking gears for tooth spacing on an Illinois machine.

labor recruited from its immediate surroundings. That this was accomplished so successfully will always be to the credit of the seasoned Studebaker top management.

Those of our readers who are familiar with airplane engine design and with its gearing, in particular, can best appreciate the problems involved in the mass-production of such gearing. Each individual gear is a unique problem in itself—due to peculiarities of form and dimensions, and due to functional considerations which dictate the choice of materials and their heat treatment. The integration of these requirements results in a process which may be characterized as a tool room or job-shop operation dealing with mass-production lots.

With few exceptions it was determined that the most efficient method of manufacture would be that of large-scale job-shop rather than the progressive straight-line departmental set-up so familiar in automotive plants. Consequently, the arrangement of the plant is on a functional basis. The equipment is grouped according to the type of operation—heat treating, gear cutting, gear finishing, cylindrical and surface grinding, etc., with work routed from one department to another in accordance with the established routing. In the process, each gear is treated individually due to the

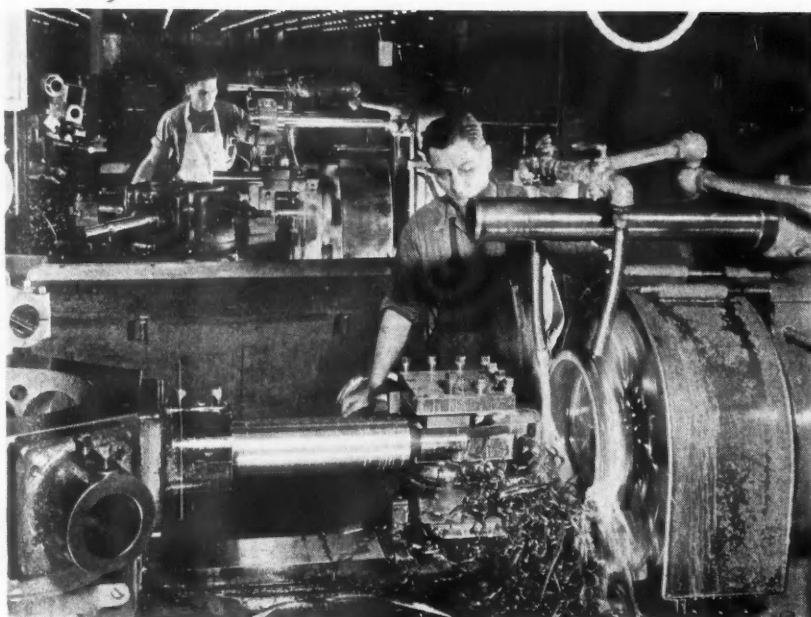
Close-up of Leland-Gifford sensitive oil hole drilling machine used for drilling the multiplicity of small holes in the trunnions.



complexity of annealing, heat treating, plating, and other steps to which it may be subjected.

Outstanding feature of the gear plant, from the standpoint of metal cutting practice, is the adoption

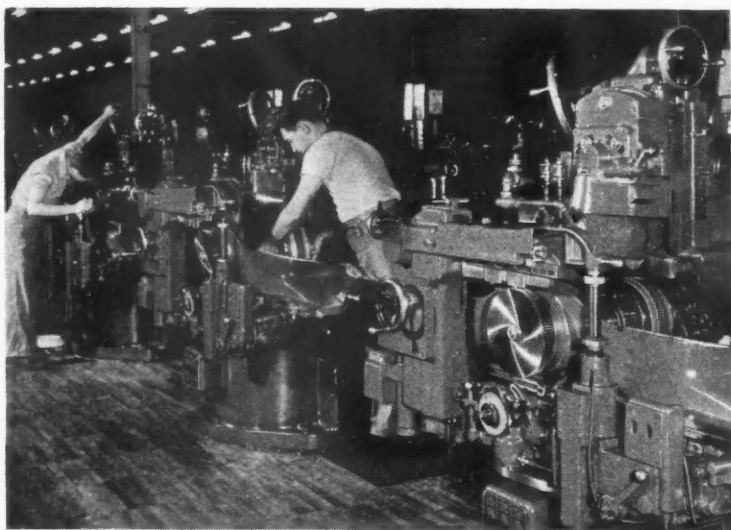
Parts and Assemblies from Studebaker to Cyclones



of cemented-carbide tools of special grades, supplied principally by Carboly, for all steel cutting. This will be recognized as the most advanced practice in the industry. It has been established that the use of cemented-carbide tools in this plant produces a beautiful surface finish, makes possible the utilization of the maximum speed and productivity inherent in modern production equipment.

Perhaps a good way to visualize the layout of the plant is to look at it from the standpoint of functional departments. This may be done readily by the following brief analysis—

HEAT TREATING—the heat treating department is self-contained, provided with a full complement of equipment to handle the variety of forms



(Left) Finish-grinding 105 teeth on stationary reduction gear is done on single-wheel Pratt & Whitney gear grinders shown here. The grinding department has a large battery of P & W single- and two-wheel gear grinders; a battery of the new National Broach Red Ring gear grinders; and Geargrind grinders.

(Below) Close-up of one of the big #5 J & L turret lathes set up in the gear department for turning, boring, and facing operations on the super-charger intermediate shaft.



and materials and their treatment. Here will be found Electric Furnace Co., annealing and carburizing furnaces and new nitriding furnaces, larger Westinghouse nitriding furnaces, drawing furnaces, and Gleason gear quenching machines. An adjunct to this department is a comprehensive job-plating section, equipped to handle the gamut of plating operations—tin, cadmium, lead, and copper.

GEAR CUTTING—the gear cutting department contains the variety of types and makes of modern gear cutting machines such as are currently available to the airplane engine industry. Here are large batteries of Fellows gear shapers for cutting internal gears, spur shoulder gears, splines, and the newly developed method of shaping three-jaw clutch teeth.

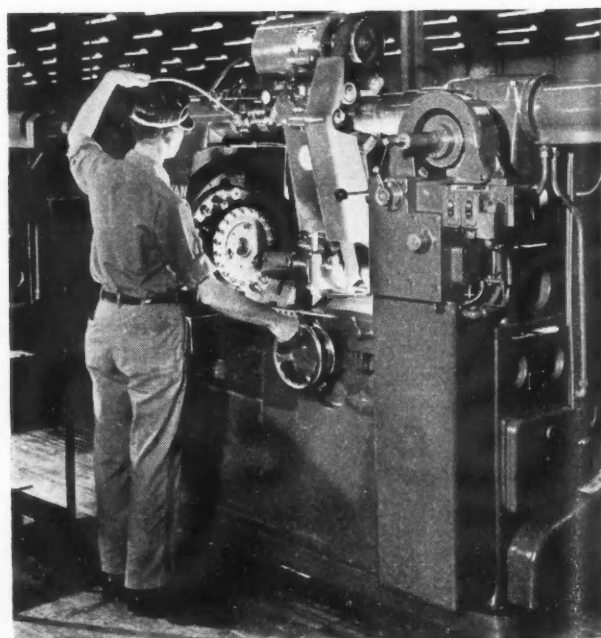
A large row of the familiar Barber-Colman hobbing machines handles many spur gears and a number of spiral gears. Cutting of the latter is an extremely fussy operation due to the requirement of uniform tooth section at the extremity of each tooth. This problem was successfully solved with the cooperation of Barber-Colman through the development of hobs of special form.

There also is a battery of Gleason generators which are used for cutting the several bevel gears required in the Cyclone bevel gear train.

GEAR FINISHING—generally speaking, Studebaker does not use gear shaving but relies entirely upon gear grinding and lapping. Three types of machines are employed for gear grinding—the well known Pratt & Whitney gear grinders; Gear Grinding Machine Co., Geargrind machines; and the new National Broach & Machine, Red Ring grinders. On the big bull-ring, the internal and the external spur gears are lapped on

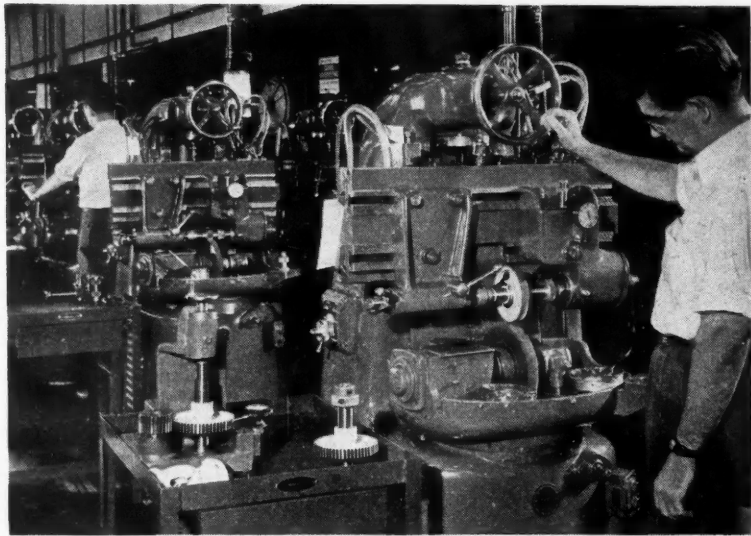
Fellows lapping machines. In addition, there is a battery of Red Ring lappers for other types of gears.

The long internal spline in the bull-ring is shaped on a Fellows, ground to precise form on a special Geargrind machine, fitted with a small formed wheel just



Unusual application of the versatile Bryant internal grinder—using a small cupped wheel for finish-grinding of each trunnion on the carrier. In this operation, a precision-indexing fixture indexes each trunnion into position.

Close-up of part of battery of National Red Ring gear lapping machines.



large enough to enter the bore. GRINDING—internal and external—this is done in a self-contained department, equipped with Heald and Bryant internal grinders for the bores; Norton, Cincinnati, and Landis grinders for cylindrical grinding.

In addition, the variety of surface grind-



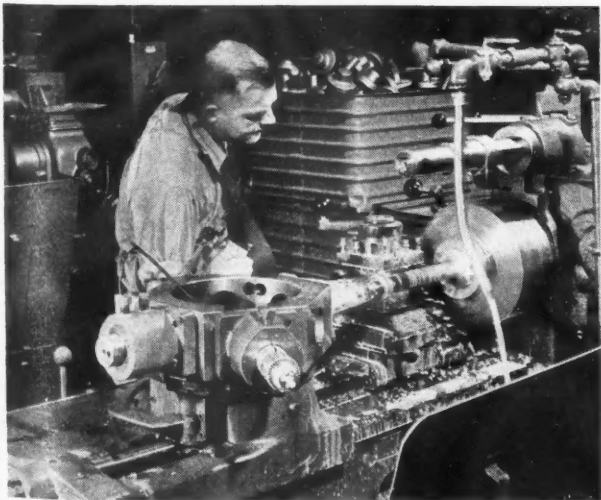
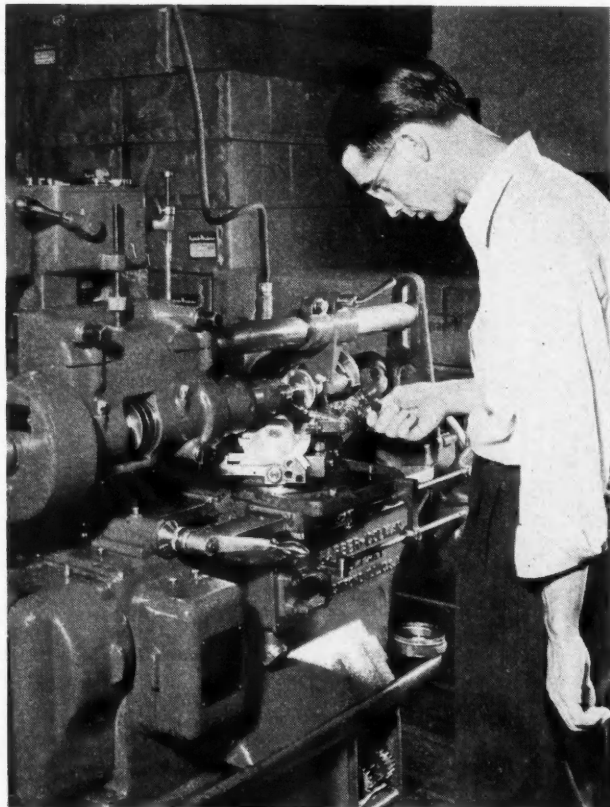
(Above) In the gear lab—Fellows involute checker with automatic recorder is shown in action on the gear of impeller drive shaft.

ing operations are handled on a battery of the large Blanchard surface grinders, Heald rotary grinders, and Arter surface grinders.

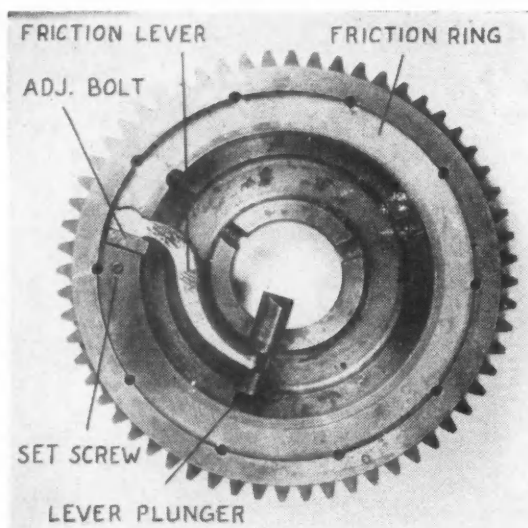
TURNING OPERATIONS—the turning department features one of the largest batteries of Gisholt turret lathes to be found in a plant of this size. Supplementing these are—Foster lathes, a battery of J & L turret lathes, and several Warner & Swasey turret lathes.

DRILLING DEPARTMENT—This contains a com-
(Turn to page 67, please)

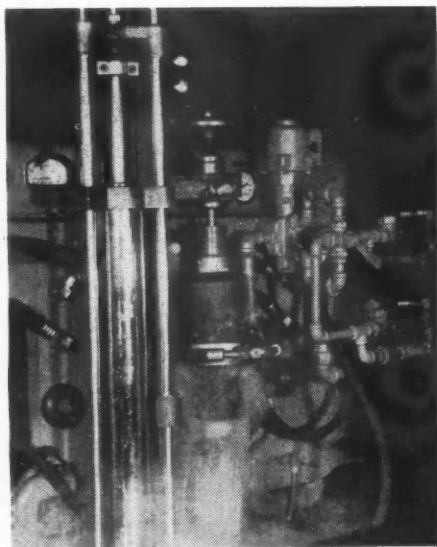
One of the small Barber-Colman hobbing machines is shown cutting spiral tooth section on a small shaft.



(Above) Part of a battery of #4 Gisholt turret lathes in the gear department. This view shows the turning of an accessory drive and starter shaft using cemented-carbide tooling.

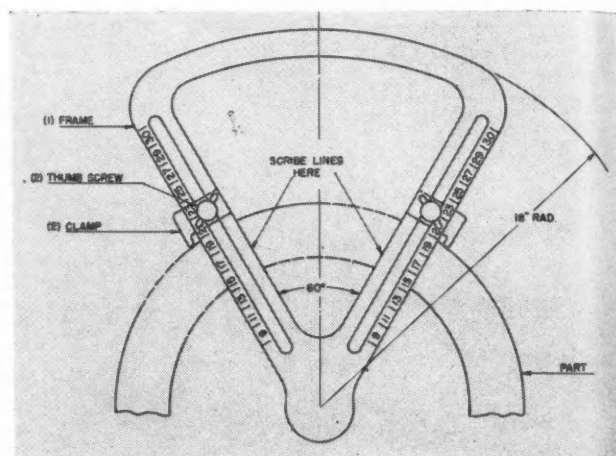


(Above) The service life of rapid-traverse clutches on vertical turret lathes is greatly lengthened at Buick Motor Division's bomber engine plant near Chicago by providing the clutch friction rings with adjusting bolts. When the friction surfaces are worn, adjustment is made by turning the bolt with a screw driver, to reduce the clearance between the friction lever and the ends of the friction ring. In making the alteration, the end face of the friction ring is cut back $\frac{3}{16}$ in. to provide space for the bolt head. A hole is drilled square with the end face, with a No. 3 drill, and is tapped with a $\frac{1}{4}$ -28 tap. A square-head bolt of the proper size is slotted at the threaded end, so that one-quarter turn adjustments can be made with a screw driver. A $\frac{1}{4}$ -28 hollow set screw $\frac{1}{4}$ in. long locks the bolt in adjustment from the side of the friction ring.



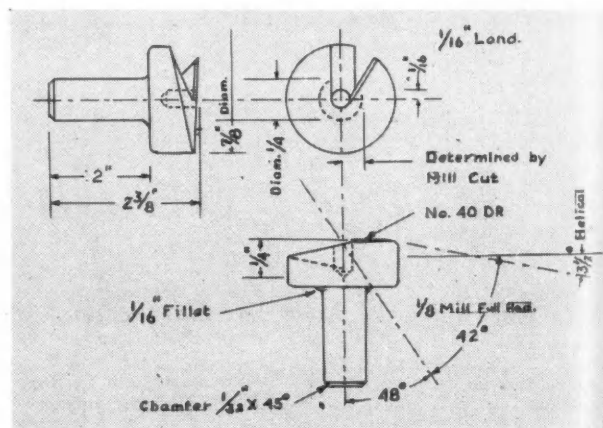
(Above) A special set of fixtures and induction coils for a Tocco Jr. machine, many of which were designed and built at the Cooper-Bessemer Corp. plant, makes it possible to harden in considerably less time 35 different Diesel engine parts ranging from $\frac{7}{16}$ in. bolts, gears, cams, ball races to large wrist pins over 6 in. in diameter and up to 18.25 in. in length. In hardening wrist pins an automatic hydraulically-operated fixture, which is shown in the accompanying photo, feeds the pin through induction coils at a controlled speed so that the entire length of the wrist pin is heated to the desired temperature and quenched in one continuous operation. Hardening time for the wrist pin now is 38 sec.

Short



(Above) This layout tool, which was devised by General Electric engineers to simplify the scribing of a metal packing ring to be sawed into six equal segments, can be adapted easily to facilitate similar jobs. To use the tool it is only necessary to measure the outside diameter of the ring to be cut, and then set the clamps at the corresponding measurement marked on each arm. The operator then scribes a line across the ring along the outer edge of each arm, and using each line scribed as a guide for the next one, completes the layout in five moves of the tool around the ring.

(Below) After aluminum tubes for aircraft oil, fuel and hydraulic lines have been cut to the proper lengths, the ends must be squared off neatly, and this was formerly done by means of a hand file or a disc sander. The specially-designed cutter for squaring and finishing the tube ends shown by the accompanying drawing was devised at the Republic Aviation Corp. The cutter is inserted in the spindle of a small drill press, and tube ends are squared and machine-finished without burrs, in considerably less time than by the former method.

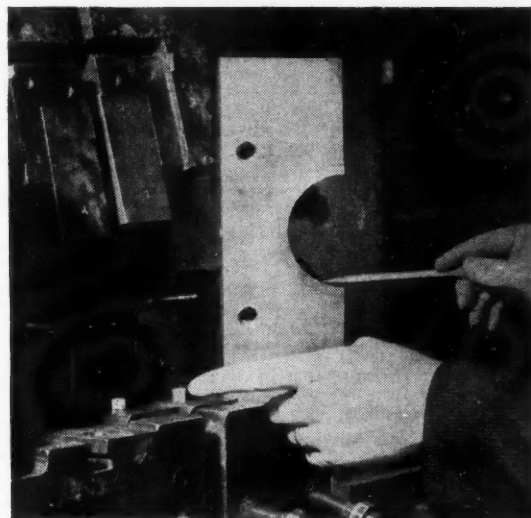


t Cuts

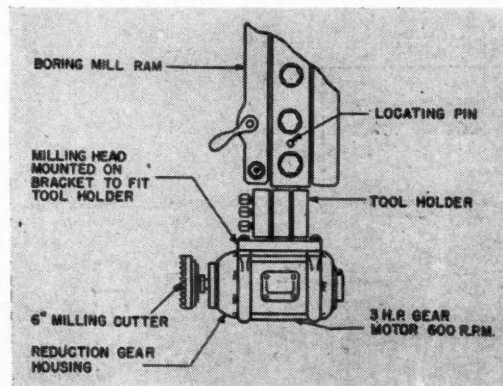


(Left) At the Mansfield plant of Westinghouse Electric & Mfg. Co. a standard tapping machine is used to perform the delicate operation of lapping female threads in an aluminum part. The problem is to avoid applying excessive pressure and destroying the soft threads. While brushing on the lapping compound, the female threads are lapped to the proper fit by passing them up and down over the male threads on the lap by utilizing the forward and reverse speeds of the machine spindle.

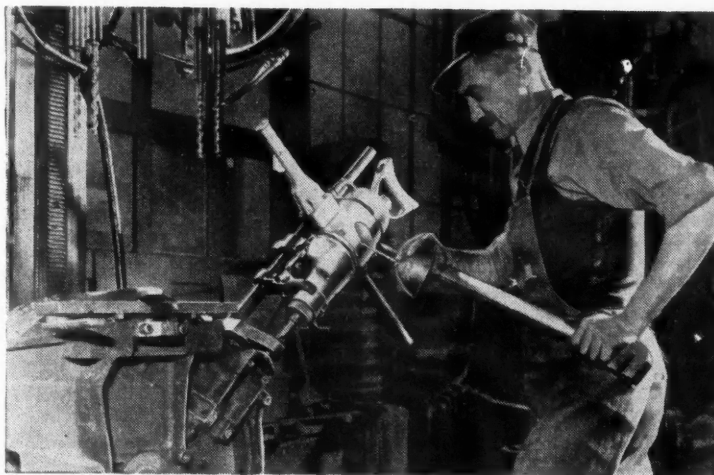
(Right) By mounting a milling cutter on a vertical head of a boring mill, General Electric engineers have found it possible to eliminate setup and handling time. The scheme also has been used to advantage in milling flat, true surfaces in correct relation to a previously machined curved surface. One application has been in milling a flat pad located inside the bore of aluminum casting while clamped in the boring mill. To use the milling head the operator first correctly locates the job in relation to the milling cutter. The cutter is hand-fed into the work and a rapid traverse may be used to move the cutter over long distances between intermittent cuts.



(Above) Formerly it was believed that electrode dies used in flash welding should be made entirely of copper. As copper is a strategic material and difficult to get, and besides, such dies are very expensive, A. E. Nelson of the Douglas Aircraft Co. suggested that Kirksite could be substituted for copper in the dies, except for an insert or lining of copper. The lining, which is shown clearly in the die in the accompanying photo, gives satisfactory service.



(Right) Here is a short cut in the machining of fifth-wheel castings as used for tractors with semi-trailers. The casting is clamped to the table of a multiple-spindle drill press, and four holes are drilled in the forward "edge". A fifth hole is required in the side of the casting, and originally this was drilled in a separate operation, for which the casting had to be specially positioned and clamped. By mounting a Van Dorn $\frac{7}{8}$ -in. heavy-duty electric drill and bench drill stand on the multiple-spindle drill press, the fifth hole is drilled without moving the casting, and production is increased 60 per cent.



AN INSPECTION by the Directors of the Curtiss-Wright Corp. on Feb. 11, 1943, marked the completion of the first unit of the Curtiss Research Laboratory. Several far-sighted men in the Airplane Division had for some years visualized the segregation of research activities away from the various plants and centralized in one unit in order to serve best the ever-increasing demand to improve all methods of air transportation. The new laboratory is the result of that forethought.

The first consideration in planning of the building was the development of a new wind tunnel, probably the greatest single tool of the industry. Preliminary design studies were made to determine the type of tunnel that would serve best the complex needs of the designers of planes, and which would do it faster than hitherto thought possible. This project was already under way when Pearl Harbor took place, which brought quick action, and early in 1942 Curtiss made, from its own funds, the first ap-

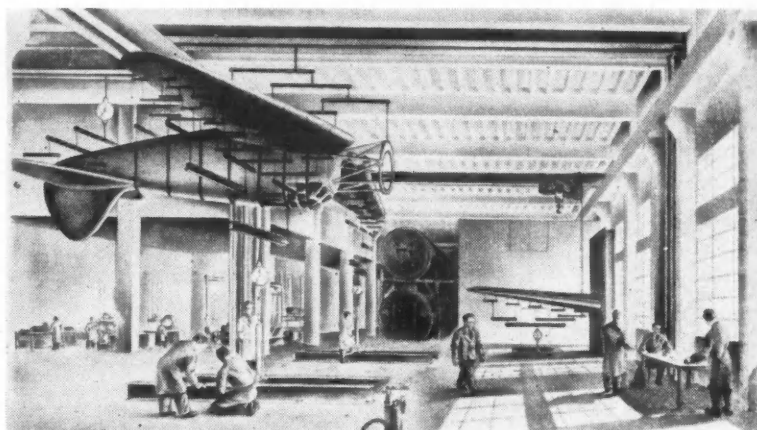
propriation for the beginning of this important work.

To the preliminary studies for the wind tunnel various consultants throughout the country made contributions. Finally a joint venture for designing an all-purpose tunnel was centered at the California Institute of Technology, as several West Coast airplane companies had decided to build a tunnel similar to the Curtiss design. Due to the tunnel's high power re-

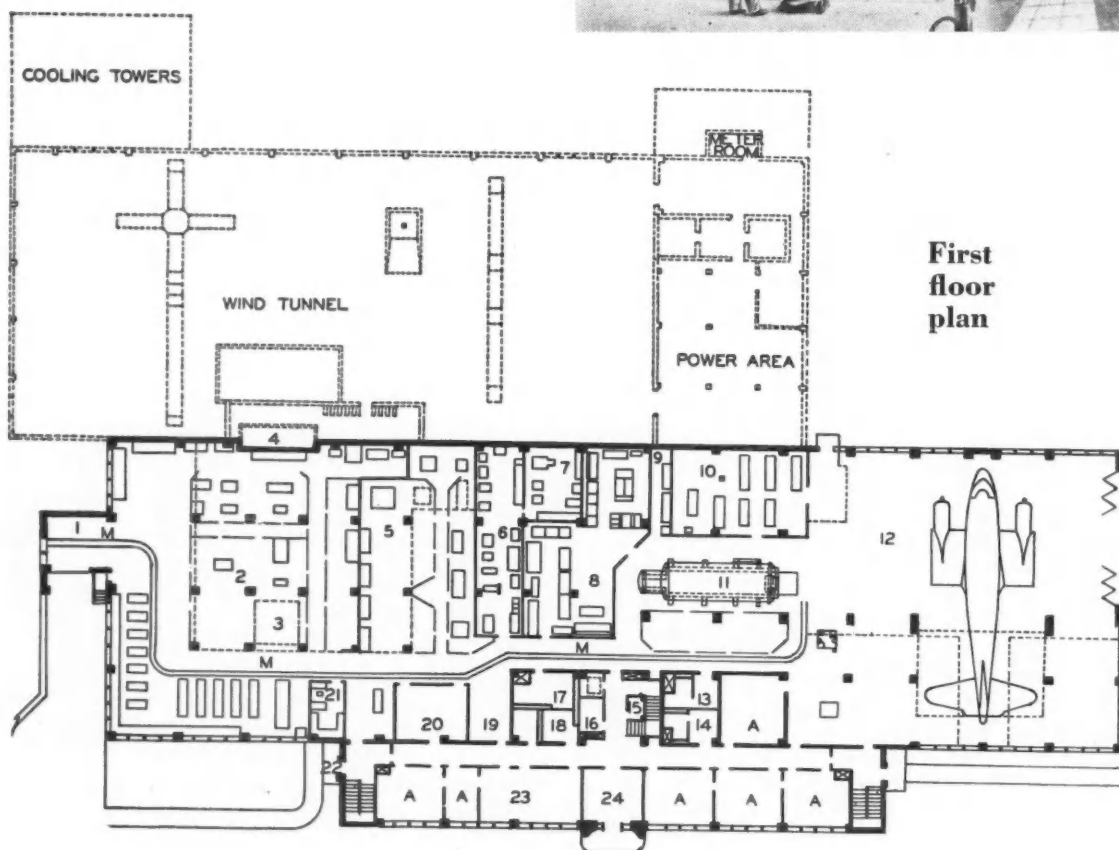
Curtiss-Wright's N

By Walter E. Voisin

Research Laboratory Manager
Airplane Div., Curtiss-Wright Corp.

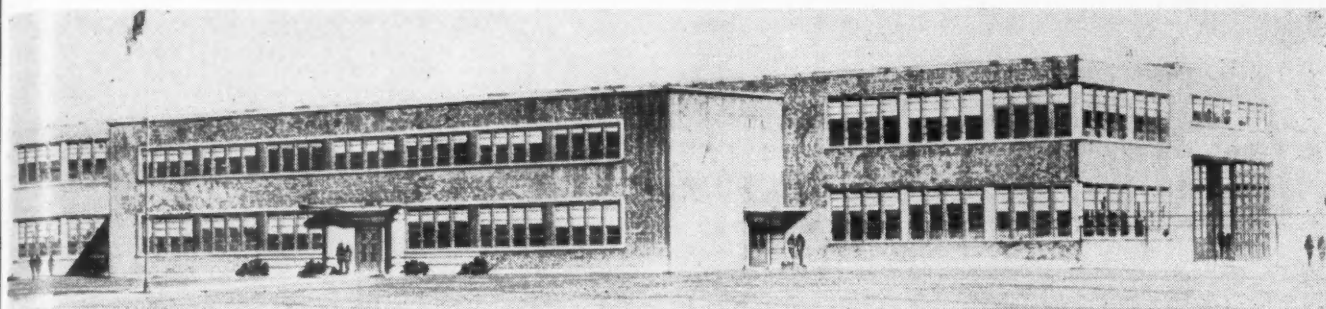


Static test area. At the rear are the altitude chambers.



First floor plan

- A. Office
- M. Monorail
- 1. Receiving Platform
- 2. Wood & Model Shop
- 3. Hatch (above)
- 4. Wind Tunnel Door Pit
- 5. Machine Shop
- 6. Wood & Plastics Shop
- 7. Humidity Room
- 8. Hydraulics Room
- 9. Cold Room
- 10. Compressor Room
- 11. Altitude Chamber
- 12. Static Test Area
- 13. Women's Rest Room
- 14. Women's Rest Room
- 15. Mail Room
- 16. Police Room
- 17. Men's Rest Room
- 18. Men's Rest Room



Artist's drawing of new Curtiss-Wright Research Laboratory.

s New Research Laboratory

quirements, which naturally make favorable power rates an advantage, and also the desirability of being near one of the larger units of the Curtiss-Wright Airplane Division, Buffalo was selected as the site for the new Curtiss-Wright Research Laboratory. The West Coast tunnel was located at Pasadena, Cal.

The wind tunnel largely determined the general layout of the laboratory, since the former utilizes approximately half of the proposed floor space, but due to the length of time necessary to complete its design and obtain the materials for it, the balance of the laboratory was started first so that it could be occupied as soon as possible. It is this unit, started on June 1, 1942, that is now occupied. In planning this

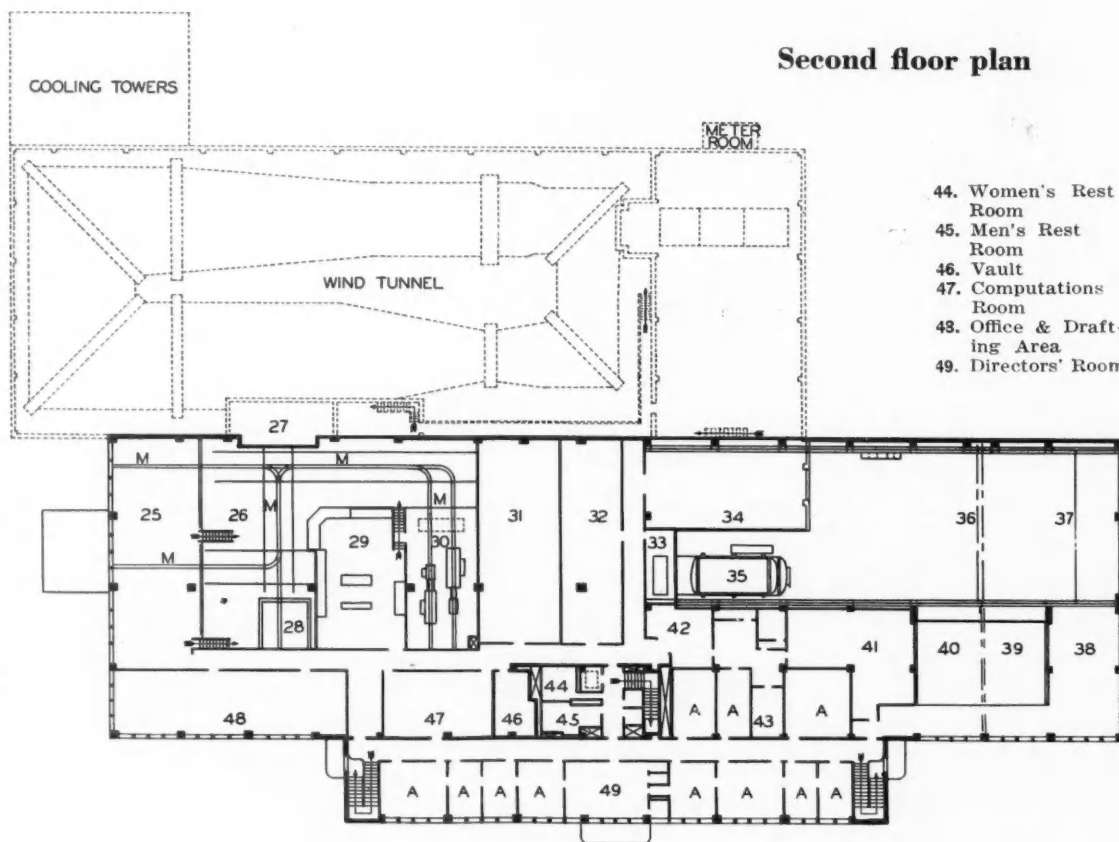
section of the laboratory the desirability of greater facilities for static test work was recognized, and also the need of a chamber which would better simulate flight conditions at high altitudes. These major requirements served to dictate the layout of this unit of the laboratory.

The accompanying floor plans show the general layout. The laboratory building is connected to the main plant by an 8 by 8 ft tunnel that is 340 ft long. It serves as a pedestrian passage and also as a means for conveying steam, air and other utilities to the laboratory. A basement under the office section receives this tunnel. The west wing of this basement is being de-

(Turn to page 60, please)

Second floor plan

- 19. Wash & Locker Area
- 20. Maintenance & Instruments Room
- 21. Tool Crib
- 22. Employees' Entrance
- 23. Library
- 24. Lobby
- 25. Model Preparation Shop
- 26. Cart Rigging Area
- 27. Wind Tunnel Door
- 28. Hatch
- 29. Control Room
- 30. Dynamometer Room
- 31. Heat Transfer Room
- 32. Electrical Room
- 33. Economizer Room
- 34. Welding Shop
- 35. Altitude Chamber
- 36. Craneway
- 37. Craneway
- 38. Drafting Room
- 39. Removable Floor Area
- 40. Craneway
- 41. Chemistry Room
- 42. Metallurgy Room
- 43. Dark Room



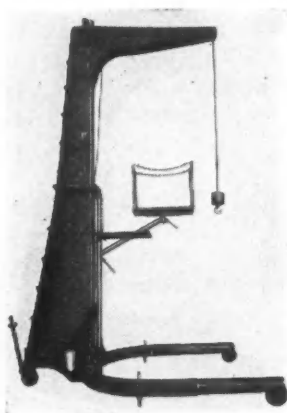
- 44. Women's Rest Room
- 45. Men's Rest Room
- 46. Vault
- 47. Computations Room
- 48. Office & Drafting Area
- 49. Directors' Room



Products for Aircraft

Portable Hoist for Aircraft Service

The Federal Aircraft Works, Minneapolis, Minn., is making Portable Hydraulic Hoists for aircraft engine service in two sizes. The Model PH 4000 hoist has a hook clearance (from floor to extreme height) of 14 ft., and a hook travel of 12 ft. Its approximate weight is 2,000 lbs. The Model PH 4002 hoist weighs approximately 3,000 lbs., and has 6 ft. greater hook clearance and hook travel. Both models have a capacity of 4,000 lbs. with a safety factor of 4, and both are available with mechanical beam lowering mechanism and towing dollies incor-

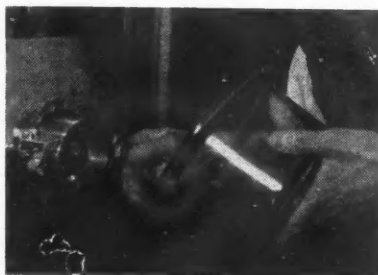


Model PH 4002 Federal Hydraulic Hoist

porated to facilitate towing across country or on the field for service and installation of aircraft engines, heavy construction equipment or field equipment. The construction of these hoists permits ready disassembly for shipment.

Longer Life for Generator Brushes

To offset the effects of thin air and low humidity at high altitudes, a new method of treating the carbon brushes for aircraft generators has been developed by Dr. Howard M. Elsey, consulting chemist of the research laboratories of Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. With this development, it is said that life of the brushes has been stepped up from an average of 2 hours to well over

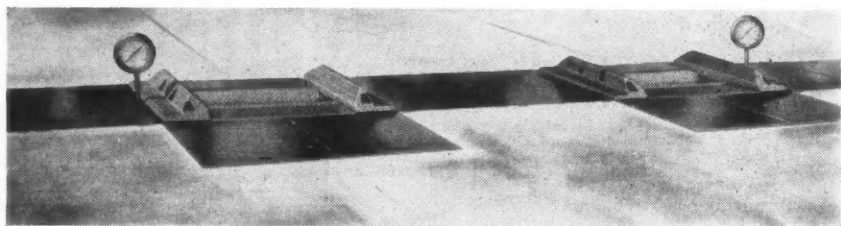


Checking generator brush operation in vacuum jar at Westinghouse Research Laboratories

100 hours for high altitude flying over 30,000 feet.

These new brushes are now being applied in bombers and fighting planes on the Westinghouse designed and built 200-ampere, direct-current, P-1 generators. These generators supply the 28½-volt power for all the electrical requirements on board.

At ordinary low-altitude flying the standard carbon brushes gave satisfactory operation, but above 30,000 feet the thin air and lack of moisture caused the brushes to wear rapidly and in many cases to give out entirely during a single flight. Since this was a serious problem to the Armed Services in high-altitude combat, Dr. Elsey went to work with brush engineers to determine what atmospheric conditions caused these failures. After extensive laboratory tests in which he observed brush characteristics in a vacuum jar and in specially designed chambers simulating high-altitude conditions, he was able to remedy the trouble by developing a special grade of brush for high-altitude flying. With proper ventilation and under average load conditions, brush wear for high-altitude flying has been reduced to one-thousandth of an inch per hour.

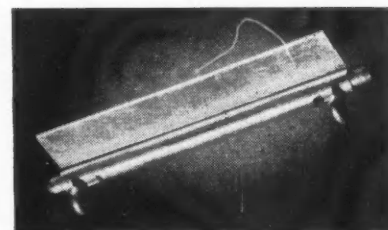


The Bennett-Peragen Aircraft Brake Tester

Burklyn Quick Release Hinges for Aircraft

Burklyn Quick Release Hinges, made by the Burklyn Company, Los Angeles, Cal., have been redesigned and adapted to a wide variety of aircraft applications. In addition to their original use on machine gun ammunition shutters, they are now adapted to quick removal of hinged doors, map or chart tables, seats in cargo planes, shelves, etc.

The unit is composed of a bracket housing spring loaded attaching pins, the latter equipped with finger pads to



Burklyn Quick Release Hinge

retract the pins. When the pads are forced together the hinged part is entirely free.

Production is now concentrated on non-critical materials, and present models are available in several bracket designs and lengths from 2 in. to 6 in.

Brake Tester for Aircraft

The Safety Equipment Co., South Bend, Ind., is offering the Bennett-Peragen Brake Tester in two sizes. The smaller machine has 36 in. rolls and handles planes up to 22,000 lbs.; the larger one, which has 72 in. rolls, has a capacity up to 80,000 lbs. plane

(Turn to page 92, please)

The Hawker

Typhoon

FIRST release of photographs and brief particulars of the Hawker Typhoon, now Britain's most formidable warplane in the single-engined fighter class, has been made in England. For some months this new type has been in full operation with RAF Fighter Command. It can be viewed as a direct and logical development of the Hawker Hurricane, which, with the Spitfire, bore the brunt of the Battle of Britain and has since been employed in a variety of services, the most recent of which is its use as a "tank buster."

The Typhoon made its initial appearance on large scale operation at about the same time as the Focke-Wulf Fw190 bomb-carrying fighter. There is, too, some resemblance in the general outlines of these two machines from certain aspects, which accounts for the "zebra" marking (black and white stripes) on the under surface of the wings of the Typhoon, for these reduce the risk of the latter being mistaken for the Fw190 by ground gunners.

The engine of the Typhoon is the Napier Sabre, a 24-cylinder H-type differing from other engines of this formation by having its cylinders horizontal. It is liquid-cooled and has sleeve valves. Precise performance figures may not be given, but the maximum speed has been stated unofficially to be over 400 mph under conditions not specified. Various unofficial figures as to engine power output have been published, these ranging from 2000 to 2400 hp.

Immediately below the engine is a large "beard" type radiator

cowling enclosing a radiator for the coolant, another for the oil and in the center of the assembly an air intake for the carburetor and supercharger. The radiator cowling is permanently open at the front, a flap at the rear being provided to control the flow of the cooling air. A three-blade controllable propeller is used. The starting system is of the cartridge type.

Two renderings of the Typhoon are in operation, the 1A and the 1B. The 1A has twelve 0.303 in. Browning machine guns, while the armament of the 1B consists of four 20 mm. British Hispano cannon.

In general design the Typhoon follows orthodox Hawker practice, the designer in both cases being Sydney Camm, chief designer of the Hawker Aircraft Co. But structurally the Typhoon differs considerably from the Hurricane. For one thing it has the stressed skin form of fuselage in place of the girder type of the Hurricane. Again, in comparison with the wings of the latter, those of the Typhoon appear to be abnormally thick. They are said to be "extremely strong" and should be capable of taking still heavier armament and enable the machine to be used as a fighter-bomber.

Ailerons extend outwards from the outer cannon of the 1B and small trimming tabs are set in their trailing edges. In the head-on view of the machine there is a noticeable crank in the wings due to slight anhedral on the central section, followed by dihedral on the outer wing sections. Almost symmetrical aerofoil sections are used on the wing.

The pilot's cockpit is much more roomy than on many fighters. Entrance is gained through a door on the starboard side. A springloaded step can be pulled

(Turn to page 90, please)

(The Typhoon from the rear, a view showing the anhedral and dihedral wing design. (Courtesy "Flight", London.)



(Left) Front view of the Typhoon 1B, showing the four 20 mm. cannon and the beard cowling of the radiators and air intake for carburetor and supercharger. (Courtesy "Flight", London.)

Warehousing Program Works

THE new enlarged aircraft steel warehousing program announced by the Steel Division of the War Production Board contains four important changes which are: 1. An increase in the quantity of steels carried by the warehouses. This increase has been as much as five times the amount previously carried. 2. The amount of material which the warehouse may ship in a given period has been changed from a quarterly to a monthly basis. 3. Aircraft manufacturers may issue blanket certificates to cover all future orders on warehouses. 4. Number of warehouses has been increased from 16 to 26. The new program will be controlled by the Aircraft Scheduling Unit.

Briefly, the purpose of the program is to supply aircraft manufacturers with both their small and emergency requirements of critical aircraft alloy steels. It will also serve in redistributing surplus alloy steels which may accumulate in the plants of aircraft manufacturers.

The accompanying chart illustrates graphically the procedure followed in this new plan.

The warehouses are located in 26 cities in 11 states and were chosen by the aircraft industry itself. A complete list of the warehouses will be found at the end of this article.

In general, only standard aircraft alloy steels will be earmarked in these warehouses, but special provisions

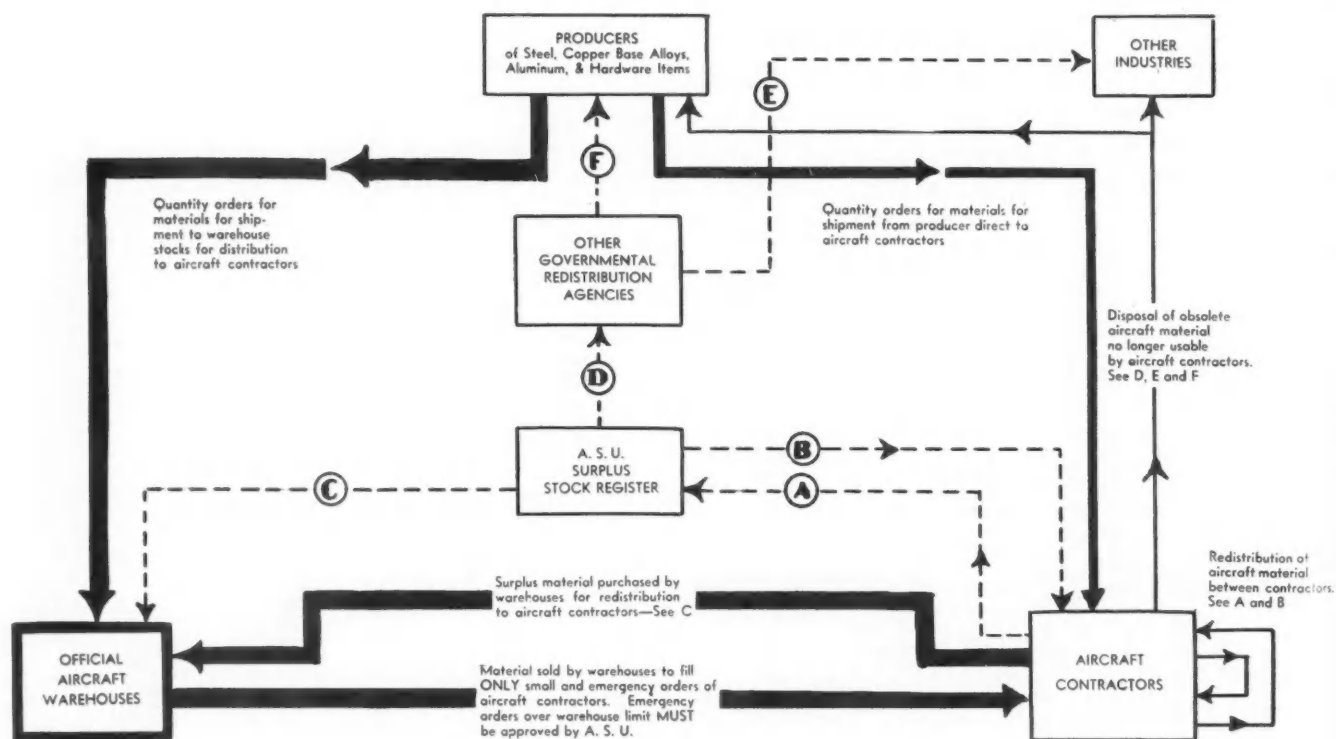
have been made to stock one warehouse with certain "non-standard" sizes and grades which are used by the industry in quantities too small for mill production. If a manufacturer is unable to secure a non-standard item in this warehouse, he should immediately notify the Army Air Forces or Bureau of Aeronautics representative in his Procurement District Office and request their assistance. If the District Office approves this request of a non-standard specification, it will forward its recommendation to the Aircraft Scheduling Unit in Dayton, which will arrange for the production of a minimum mill quantity. The amount required by the manufacturer will then be shipped to him and the balance placed in the warehouse stock. The production of non-standard items will be approved only in very exceptional cases, and manufacturers will do well to explore the use of all available stocks.

These earmarked aircraft steels may be used only for aircraft construction, maintenance, repair, and airborne parts including the airframe, engine propeller, accessories and any other regular equipment for the airplane. These steels may not be used for jigs, fixtures, or ordinary ground equipment, (Turn to page 76, please)

Flow of Materials Through Official Aircraft Warehouses

- A. Reports of surplus stock from aircraft contractors**
- B. Reports location of surplus stock to relieve shortages**
- C. Reports to warehouses surplus stocks available for redistribution**
- D. Reports to other agencies obsolete materials not wanted**

- E. Reports to other industries obsolete aircraft stock**
 - F. Reports to metal producers obsolete stocks available for scrap**
- Solid Lines: Flow of new and surplus aircraft material**
Broken Lines: Controls for flow of surplus material



Machine Output UP 37% TO 110% with INLAND LEDLOY

LEDLOY is the lead-bearing, faster-machining steel that produces more parts per hour, lowers labor and machine costs, and increases tool life up to 300%.

Inland Ledloy is open hearth steel containing a small percentage of lead added by a special Inland process. This addition of lead results in slight refinement of grain structure and greatly increased machinability. In all other physical properties—yield strength, ultimate strength, elongation, reduction of area, etc.—Inland Ledloy is the same as open hearth steel of similar analysis.

Today, Inland's entire production is being used by war industries to help win the fight for freedom, but when peace comes Ledloy will again be available for general manufacturing use.

**Write for further information
on Inland Ledloy**



"Foreign Agent"—LEDLOY LIMITED
66 Cannon Street, LONDON

Reports on five Inland Ledloy case studies recently made in British munition plants:

No. 1—Bottom Bracket Cycle Spindle

	Free Cutting Steel	Inland Ledloy
Spindle speed	500 r.p.m.	700 r.p.m.
Time per piece	59 sec.	28 sec.
Tool steel	18% tungsten	18% tungsten
Increased production	—	110%

No. 2—Grease Nipple

	Free Cutting Steel	Inland Ledloy
Spindle speed	2,495 r.p.m.	4,140 r.p.m.
Time per piece	20 sec.	13 sec.
Increased production	—	53%
Increased tool life	—	300%

No. 3—Set Screw

	Screw Stock	Inland Ledloy
Spindle speed	490 r.p.m.	693 r.p.m.
Time per piece	95 sec.	69 sec.
Increased production	—	37.6%

No. 4—5/16" x 2" Bolt

	Screw Stock	Inland Ledloy
Spindle speed, turning	896 r.p.m.	1,126 r.p.m.
Spindle speed, threading	296 r.p.m.	373 r.p.m.
Time per piece	21 sec.	13 sec.
Increased production	—	62%
Increased tool life	—	300%

No. 5—Locknut Blanks

	Free Cutting Steel	Inland Ledloy
Spindle speed	2,140 r.p.m.	2,140 r.p.m.
Time per piece	18 sec.	10 sec.
Increased production	—	44%
Increased tool life	—	50%
Spindle speed, tapping	950 r.p.m.	2,200 r.p.m.
Increased life of tapping tool	—	200%

INLAND STEEL CO.

38 S. Dearborn Street, Chicago

Sales Offices: Milwaukee • Detroit • St. Paul • St. Louis • Kansas City • Cincinnati • New York

New Production Equipment

THE Snyder Tool & Engineering Co., Detroit, Mich., has developed a semi-automatic machine for weighing and balance-milling connecting rods of internal combustion engines.

For the purpose of this operation, a small amount of excess stock is left on each end of the forging and by milling into this metal, excess weight is accurately removed.

The workpiece is first weighed and the amount of excess stock on each end

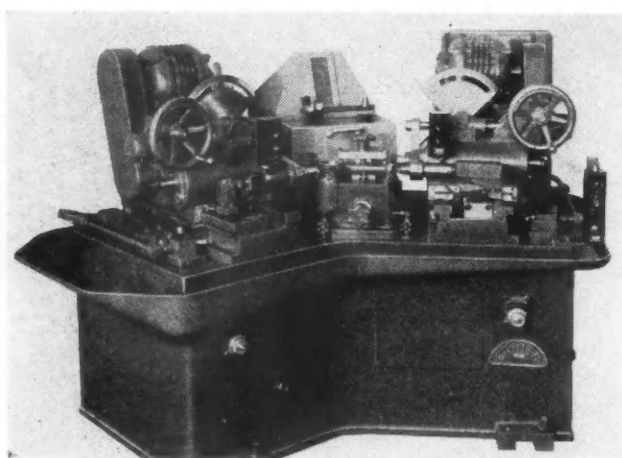
handling one connecting rod, and the distance between centers in the large and small pin holes is fixed. However, by providing suitable adjusters on the scale and fixture, two or more connecting rods of various lengths and weights can be balance milled on a Snyder machine of this type. Among the unique features of this machine is the use of lights to indicate accuracy in locating the stock to be removed. An excess adjustment of as little as .002 in. causes

thetic rubber, and toluene for explosives, is being manufactured by the General Electric Company, Schenectady, N. Y. The "robot" is said to control the flow with machine-like precision, minimizing the possibility of human error. If anything goes wrong, such as a valve sticking open or shut, the control sounds a warning by ringing a bell or blowing a horn.

The operator's section of the "robot" consists of a long control panel somewhat resembling the main switchboard in a telephone exchange. Covered with banks of switches, dials, lights, and other indicators, it is the focal point for valve control. When a valve is opened or closed, a light on the board goes on. If any valve should fail to open or close, the board would automatically suspend further operations and sound the alarm for an operator. A glance at the board would give the operator the trouble location and he could arrange for quick repairs.

THE Morrison Engineering Company, Cleveland, Ohio, has just brought out three new annealing machines for steel cartridge cases. The 3740 size will handle all 37 mm and 40 mm cases, the 5710 size handles the 57, 75 and 105 mm cases, and the Model 390 takes care of the 90 mm and 3-in. anti-aircraft cases. All models are of the same general design, the principal difference being in the size of the machine to handle the various diameters and lengths of the cartridge cases. Production varies from 400 to 2000 cases per hour.

A steel conveyor chain placed on its (Turn to page 78, please)



Snyder Semi-Automatic machine for weighing and balance - milling connecting rods

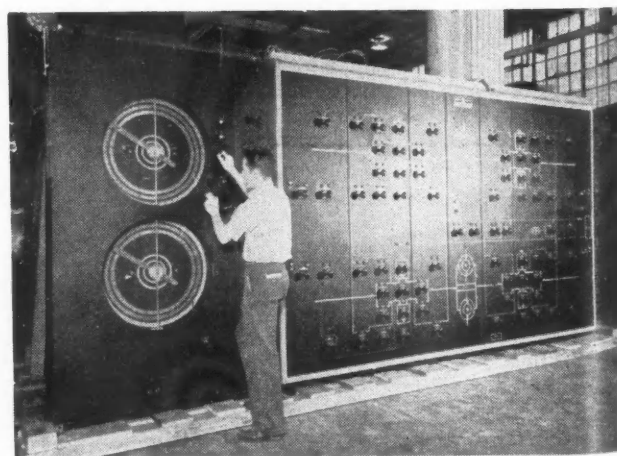
determined by means of a double dial shadowgraph scale. The piece is then clamped in the fixture manually and by turning a hand wheel, the operator advances a finder which locates the excess metal on the connecting rod and immediately flashes on a green tell-tale light. This operation automatically brings the cutting tool into perfect alignment with the tip of the finder. Should the operator turn the wheel too far, a red light flashes on and stays on until the wheel is reversed to bring the tool back into perfect alignment. The operator then sets the pointer on the fan-shaped dial, which is located above the milling unit, at the amount of excess stock which the scale indicated must be removed. This sets the cutter in position to remove that amount of stock. When these settings are made for each end of the connecting rod, an electric push button is pressed and both units feed cutters past the work, removing the excess stock and bringing the rod to correct balanced weight within the usual quarter-ounce limit.

The machine shown is designed for

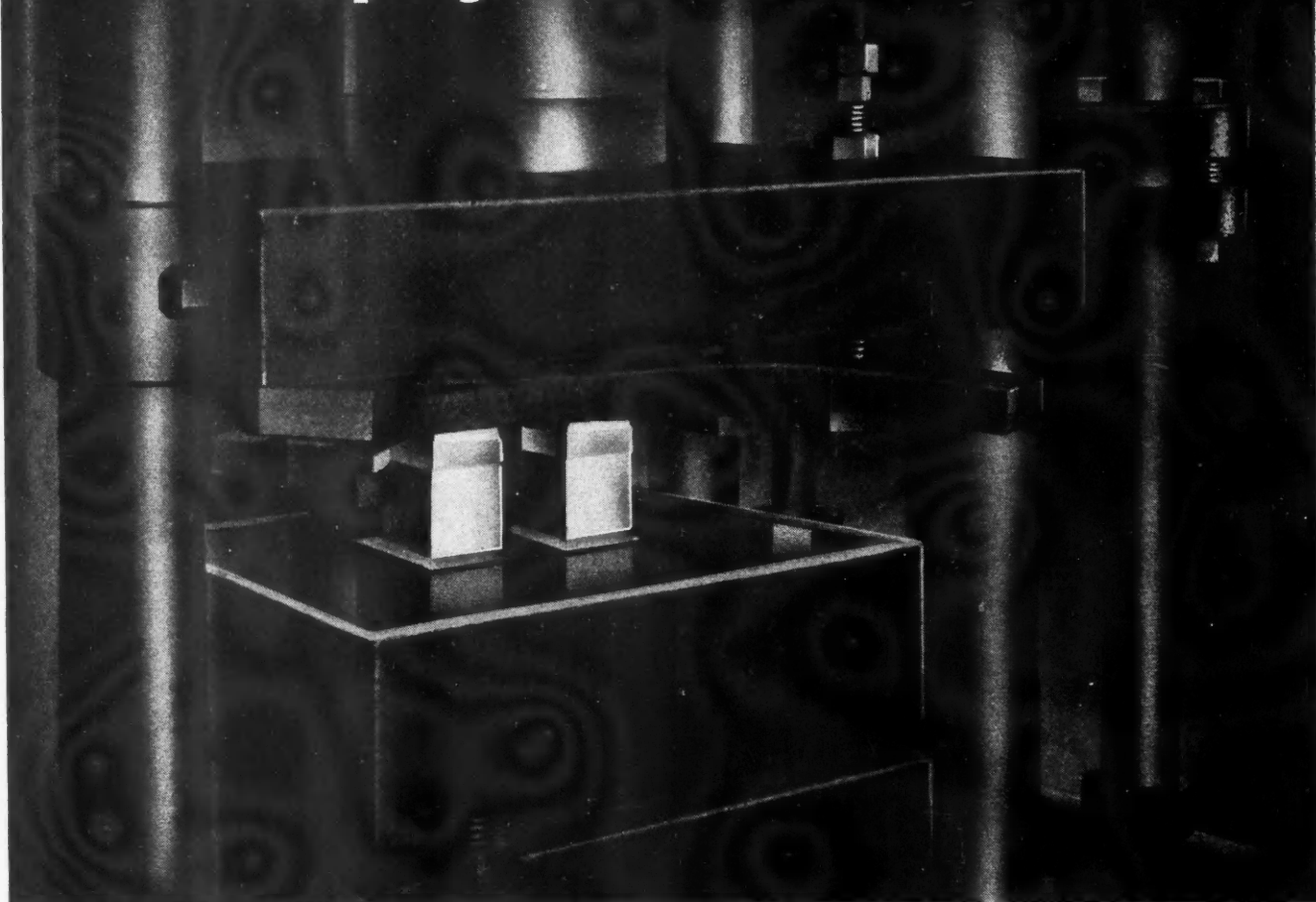
the red light to flash on and warns the operator to retract his adjustment until only the green light remains lighted.

A "ROBOT" control, which opens and closes dozens of valves at exact intervals to control the processing of aviation gasoline, butadine for syn-

Operator's section of a General Electric "Robot" Control.



Die spring failure can be checked



Information supplied by an Industrial Publication

A recent investigation of die spring breakage developed the following prominent causes:

1. Hydrogen embrittlement resulting from plating, pickling or cleaning.
2. Incorrect die design.
3. Incorrect spring size.
4. Speed of compression cycle.
5. Poor quality of wire.

There are, fortunately, remedies for all these conditions. Hydrogen embrittlement can be corrected by heating plated springs to about 450°F. and air cooling.

Faults in die design usually consist of either insufficient or too great clearance between the

outside diameter of the spring and the guide hole. The clearance should be such that the spring operates freely, but has no chance to buckle.

Care should be taken in selecting springs to see that they are properly designed for both length of compression stroke and speed of compression. If springs are repeatedly compressed too close to their solid height, quick failure will result. The same is true where the rapidity of compression is too great.

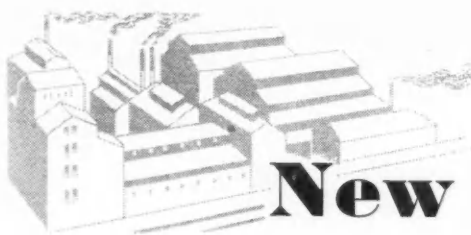
It seems obvious that the quality of the spring wire should be commensurate with the job. Cheap wire should be avoided because of defects that are bound to cause trouble, especially when springs are plated.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

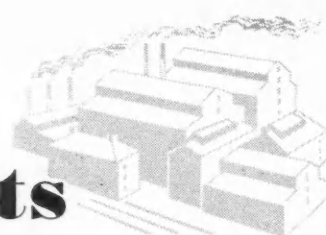


MOLYBDIC OXIDE, BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

Climax Mo-lyb-denum Company
500 Fifth Avenue • New York City



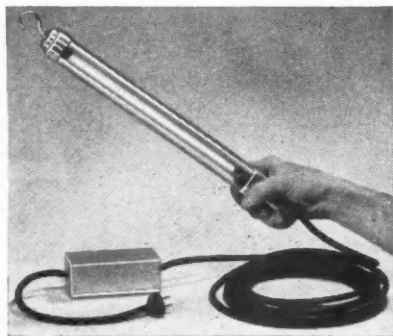
New Products



New Fluorescent Inspection Light

Designed to meet new requirements of inspection notably in war industries, Commercial Reflector and Manufacturing Company, Los Angeles, Cal., has just introduced a new Fluorescent Inspection Lite.

Adapting the streamlined shape of the fluorescent lamp together with the unbreakable safety features of plastic



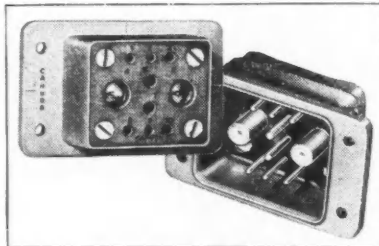
Portable Fluorescent Light

Lucite, Commercialite's portable light meets inspection problems arising from inaccessible places in many types of industrial applications.

The light is easily taken apart for lamp replacement by removing two screws. Combination metal light baffle and support shields light from inspector's eyes. Cord plug and ballast box with 20 ft. of cord are standard equipment.

Cannon Type DP-B Connector

A rack type connector, the DP-B10C2, has been added to the DP line of electrical connectors made by the Cannon Electric Development Co., Los Angeles, Cal. It is adapted by its design to radio rack assemblies, transmitters, and any general applications where both plug and receptacle must be fixed permanently in their respective units of equipment. Differing from the standard round or oval faced connectors, the DP-B is rectangular and is so designed to fit rack equipment. The shell is tapered to assure a close fit when engaged and the two units of the complete connector are self aligning, but are dependent upon



Cannon Connector

the accuracy of the equipment it connects.

The insert insulation is made of molded phenolic, having 8 standard contacts of silver plated brass, and 2 coaxial contacts of the same material and finish, with isolantite insulators. Two contacts are 30 amp. and 6 are 15 amp. The shell is diecast aluminum alloy, with sand blast and clear lacquer finish.

Wrinkle Finishes Without Chinawood Oil

A new line of wrinkle finishes, containing no Chinawood oil, has been developed by Maas and Waldstein Company, Newark, N. J.

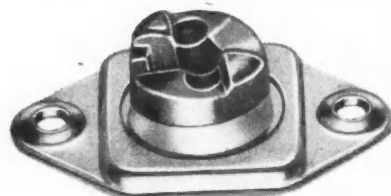
These new "Victory" finishes closely resemble the standard wrinkle finishes, the manufacture of which is now restricted by government order for a few special applications because of the Chinawood oil shortage. According to the manufacturer, the new finishes form hard, durable coatings, cover rough metal surfaces effectively in a single coat, and are applied in regular wrinkle patterns by the same methods. They are obtainable in a full range of colors and make this once widely-used type of finishes again generally available.

P&H Announces a New A.C. Electrode

An all position electrode, designed especially for use with a. c. transformer welding machines, has been placed on the market by the Harnischfeger Corporation, Milwaukee, Wis. The new electrode is said to be suitable for all mild steel applications, and is being made in the usual sizes of 1/8, 5/32, 3/16, 1/4 and 5/16 in. It is supplied in either 14 or 18 in. lengths, packed in standard 50 lb. containers.

Floating Cam Collar

A Floating Cam Collar, which allows large spotting tolerances, is the latest addition to the Camloc line of high-speed cowl fasteners being offered by the Camloc Fastener Corp., New York, N. Y. Other cam collars include straight, corner, ear and bracket models. Rivet type cam collars are used for interchangeability with other fasteners and where limited edge



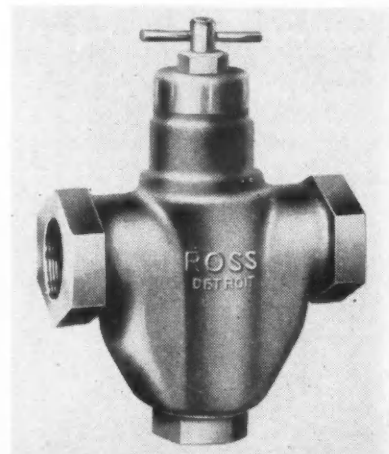
Camloc Floating Cam Collar

clearance prevents Camloc's standard single hole mounting. They are adaptable to metal, plastic and plywood.

Air Speed Control Valve

An Air Speed Control Valve which provides accurate timing of piston movements is being offered by Ross Operating Valve Company, Detroit, Mich.

It is said that starting with full capacity flow in both directions, the flow in one direction can be controlled over a wide range to a completely closed position. An increased range of selective speeds is obtained through a vernier-like adjustment mechanism.



Ross Air Speed Control Valve




Flexible at Extreme Temperatures!

In the sub-zero cold of the stratosphere . . . often dropping to 70 or 80 degrees below zero . . . Permatex Aviation Form-A-Gasket does not become hard, crack or fly to pieces.

In the high temperatures of the desert . . . often reaching 140 or 150 degrees above zero . . . Permatex Aviation Form-A-Gasket does not melt or run.

Permatex Aviation Form-A-Gasket is a heavy liquid that flows smoothly from the brush and is easy to apply. It produces a non-drying, flexible seal that is leak-proof to fuels, lubricants and other liquids used in internal combustion engines. It disassembles very readily.

Used in the machines of war and in the machines of peace!



PERMATEX COMPANY, INC.

Sheepshead Bay, N. Y., U. S. A.

100,000 Airplanes Have Been Built in U. S. Since June, 1940

Average Weight of Planes Increasing, Representing Additional Armor, Firepower, Bomb Load and Performance

Production of the 100,000th airplane in the three years since the national defense program began June 1, 1940, as announced by James F. Byrnes, war mobilization director, at Spartansburg, S. C. May 31, points up the fact that the aircraft manufacturing program is reaching the high volume output stage. Breaking down the total by years, Byrnes reported that 10,143 planes were produced in the year ending June 1, 1941, 30,248 planes were turned out in the year ending June 1, 1942, and nearly 60,000 planes were manufactured in the year ending June 1, 1943. Thus average monthly output in 1940-41 was 845 planes per month, in 1941-42 it was 2,520 planes per month and in 1942-43 it was almost 5,000 planes per month. Actual production of more than 5,000 planes in a month was reached in December, 1942, when the total was 5,489. Latest month for which an official estimate is available was approximately 7,000 planes produced in April, according to Donald M. Nelson.

That monthly output in 1944 will pass the 100,000 mark was indicated recently by C. E. Wilson, executive vice-chairman of WPB, who asserted that by April, 1944, schedules call for more than three times as many aircraft as in April, 1942, weighing six times as much. Production in May, 1942, was announced as 4,000 planes, so April's output in that year probably was several hundred less.

Commenting on the aircraft production program, Wilson said, "The two most significant developments in the aircraft program to date are the increased emphasis on heavy—and heavier—bombers, dictated by the proved quality and effectiveness of these craft, and the steady increase in the average weight of all combat types, representing additional firepower, armor, bomb load and over-all performance. While we produced almost twice as many planes last month (Nelson's estimate for April was 7,000) as we did in April, 1942, their total weight was almost three times greater. . . . The average weight per plane this year is 30 per cent greater than last. In 1944, this figure will rise to 60 per cent."

"American factories turned out almost four times as many heavy bomb-

ers last month as were produced in April a year ago. Ten per cent of all the planes that rolled from the assembly lines last month were 4-engine bombers, as compared to 5 per cent a year ago. By April of next year, schedules call for the production of today's heavy bombers at a monthly rate eight times greater than in the same month in 1942. This does not include the scheduled output of the new super-bombers. Increased output of all of these heavier planes doesn't mean that we aren't getting the numbers, too. Our schedules this year call for almost three times the number of both fighters and all bombers that were produced in 1942.

"The proportion of trainers, on the other hand," Wilson explained, "both in numbers and by weight, has steadily declined. Out of every 100 planes turned out in April, 1942, 40 were trainers. Last month this figure had dropped to 30 (more than 2000 trainers) and by this time next year it will be 15. Considered in terms of weight, the de-

(Turn to page 62, please)

Henry Ford Again President Of the Ford Motor Company

Henry Ford returned to the presidency of the Ford Motor Co. after a 25-year lapse when he took over the top executive position at a meeting of the board of directors June 1 at Dear-

born. He assumed the presidency to succeed his son, the late Edsel B. Ford, who died May 26 following a six-week illness. Henry Ford, who will be 80 on July 30, thus again took over active direction of the company which he founded in 1903 and turned over to his son in 1919 after buying out the other stockholders.

Five new directors of the family-controlled company also were elected—Mrs. Edsel B. Ford, Harry H. Bennett, personnel director; Mead L. Bricker, general manager of the Willow Run bomber plant; Ray R. Rausch, superintendent of the Ford Rouge plant, and B. J. Craig, formerly secretary. Craig was elected a vice president and treasurer, succeeding Edsel Ford in the latter post. Four directors re-elected were Henry Ford, C. E. Sorensen, vice president; Henry Ford II and Benson Ford, the latter two sons of Edsel Ford, both of whom at present are serving in the armed forces.

H. L. Moekle, formerly assistant secretary, was elected secretary and assistant treasurer. H. E. Schluchter, formerly cashier, was elected assistant secretary. He has been with the company since 1907.

Wibel Now with Nash

A. M. Wibel, who resigned last month as vice-president and director of purchases of the Ford Motor Company, has been elected a vice-president of the Nash Kelvinator Corporation. President Geo. Mason said that Mr. Wibel would aid the company with war contracts and with plans for future expansion in the automotive field. W. F. Armstrong, vice-president, and Frank R. Pierce, vice-president in charge of sales, have resigned their positions with Nash Kelvinator.

The New German Mark VI Tank

Side view of a German Tiger tank which was wrecked in Tunisia. It carries an 88 mm. gun, which weighs over 1½ tons, and two 7.92 mm. machine guns. The tank is 20½ feet long, 12½ feet wide, and probably weighs between 55 and 60 tons.



British Combine Photo



"WE WON IT BEFORE— WE'VE WON IT AGAIN!"

"NOT ALL of us were present back in 1917 when our Company received an Award from Secretary of War Newton D. Baker 'for Distinguished Service, Loyalty, Energy and Efficiency in the Performance of War Work'—but some of us were.

"And the records these Alvey-Ferguson men hung up during the First World War have been a great inspiration to all of us!

"Long before Pearl Harbor we started to break our previous records. It wasn't easy, but as our government turned from 'defense work' to 'all-out war production' our work in turning out conveying systems and metal products cleaning and finishing equipment took on a new and fuller meaning.

"By helping to speed the ammunition to our fighting men we are helping to shorten the war and save the lives of many Americans.

"Naturally, we are proud that our work has been recognized and that the Army-Navy 'E' flag 'for excellence in the production of materials for war' flies over our plant.

"We're going to keep that 'E' flag flying until Victory is ours—not only on the production front—but on the war front!"

The Men and Women of

THE ALVEY-FERGUSON COMPANY

23 Disney Street



Cincinnati, Ohio

**ENGINEERS AND MANUFACTURERS OF CONVEYING SYSTEMS
AND METAL PRODUCTS CLEANING AND FINISHING EQUIPMENT**



New Mid-Central Procurement District

Col. Alonzo M. Drake, formerly district supervisor of the Central Procurement District, Army Air Forces Materiel Command, with headquarters in Detroit, has been transferred to Chicago to set up the new Mid-Central Procurement District. The Mid-Central District will comprise Illinois, Indiana, Iowa, Wisconsin and Minnesota, all formerly part of the Central District.

Steel Requirements for Aviation Tax Capacity of Steel Mills

Aviation Programs of the Allies Will Continue To Call for Increasing Amounts of Alloy Steel

By W. C. Hirsch

Steel requirements of the aviation industry, even after being put through the CMP reduction hopper, tax the capacity of mills with the necessary equipment and staffs to do justice to this exacting class of business. This is especially true of alloy tubing, demand for which has featured the steady expansion of airplane construction material. While developments on the battlefronts are certain to bring more and more changes in the rate at which many armament and munition parts are being scheduled by procurement agencies, it is felt that the aviation programs of the Allies will continue to call for steadily mounting tonnages of alloy steel and the lighter non-ferrous metals until the end of the war. A recent Canadian steel market report spoke of heavy cancellations of orders for alloy steels by gun manufacturers with a compensating increase in the demand for ship plate. This simply bears out the widely held belief that the Allies' arsenals contain certain types of ordnance in adequate quantities and that this will permit of diverting considerable tonnages of steel and other metals to war uses not yet so well provided with reserves. The campaign of education being waged to bring about better results in the segregating of alloy steel scrap is beginning to bear fruit. This campaign really began during World War I and it is chiefly in the smaller of the new war material plants that improper classification of scrap is still encountered. The problem of bushy turnings, which make up a large part of the current alloy steel scrap output, is being solved in England by the installation of chippers and crushers. Treatment by these permits more than half of this type of scrap to be reused in the form of short shoveling grades, the remainder being charged into blast furnaces. Scrap dealers, as was to be expected, have entered objections to the suspension of

The Central District, once embracing 14 states from Canada to the Gulf of Mexico, now will be composed only of Michigan, Ohio and Canada. The change is part of a nation-wide decentralization of AAF Materiel Command personnel which will take 3,000 officers and 12,000 civilians from Wright Field, Dayton, Ohio, and place them in district and area offices throughout the country. Col. Alfred Johnson, formerly assistant chief of the production division at Wright Field, succeeds Col. Drake as Central District supervisor.

the 60-day turnover requirement for automobile graveyards. This step was taken to facilitate the saving of parts useful in the maintenance of transportation. It is expected to lop 1,000,000 tons from the 2,500,000 tons of this year's auto graveyard scrap crop.

In order to obtain the necessary production of aluminum rivets, which are used principally in airplane manufacture, a report by Jesse Jones, Secretary of Commerce, to the Joint Committee on Reduction of Non-Essential Federal Expenditures says, it was necessary to have them produced by high cost manufacturers who are not normally in the business. Defense Supplies Corporation has agreed to subsidize the production of these rivets at an estimated loss of \$5,000,000 a year. This applies also to aluminum rod, on which Secretary Jones reports an estimated loss of \$1,000,000. In the same report, the estimated cost of premiums on certain excess production of copper, zinc and lead is placed at \$80,000,000 for 1943. How much of this sum will be required for payments of premium on copper, will not be known until Mr. Jones releases this detailed information, but the subsidy policy is coming in for considerable criticism, not so much because of its cost as because, in the opinion of many, it does not result in bringing to the market more adequate supplies of the red metal. A report by mine cost experts, made to the OPA before adoption of the current maximum price of 12 cents a pound placed the average cost of domestic production at 13½ cents. It is contended that a level nearer to this finding would have resulted in a larger supply than the offering of subsidies to high cost producers.

Recognizing the growing demand for many non-standard shapes and sizes of magnesium and its alloys, OPA has authorized addition of 1 cent a pound to maximum base prices on special shapes and sizes.

Lockheed Acquires Interest in PFC

Lockheed Aircraft Corporation has acquired the majority interest in Pacific Finance Corporation of California through the purchase of stockholdings of Transamerica Corporation and associates.

This announcement was made following a meeting of the directors of Pacific Finance, at which time resolutions were adopted calling a special meeting of the corporation's stockholders on June 23, to make callable the Series A and C preferred stock, and to authorize the reduction of the capital of the corporation by the retirement of not to exceed 182,852 common shares. The reported consideration for the 381,205 shares involved in the sale was \$15.25 per share, and it was indicated that the aircraft company will shortly offer a similar price to minority common stockholders for the shares they hold. However, after retirement by Pacific Finance Corporation of the common shares, Lockheed's investment in the company will amount to approximately \$3,750,000.

The Pacific Finance board appointed Robert E. Gross, Courtlandt S. Gross, Charles A. Barker, Jr., Cyril Chappell and Corson W. Ide, as directors at a recent meeting to fill existing vacancies.

Lempco Purchases Evans Reamer Co.

The purchase of the Evans Flexible Reamer Co. of Chicago, by Lempco Products, Inc., Bedford, Ohio, has just been announced by James E. Strnad, president of Lempco. The Evans name will be retained in the new corporate title which has been changed to Evans Reamer & Machine Co. Officers of the new corporation are James F. Strnad, president, O. T. Hillshafer, executive vice-president, John Y. Blazek, treasurer, and Herbert A. Spring, secretary.

The Evans factory will continue in its present location at 4541 Ravenswood Avenue, in Chicago, and no change in the Evans personnel is contemplated. Mr. William Evans, inventor of the Evans Hi-Speed Flexible Reamer, and president of the former company, will continue his active interest in experimental work and will serve in a consulting capacity on the engineering staff of the new company.

P.M.I. Opens New Office

In addition to its administrative offices at 19 West 44th Street, New York, N. Y., the recently organized Pressed Metal Institute has established an office at Press Building, Corner of 14th and F Streets, N. W., Washington, D. C., so that continuous contact will be maintained with Government departments responsible for production of war materials.



"JUST wanted you to know you're missed here at Sealed Power—the whole crew, all your pals, send their regards. George's dad is holding down your old station at the tool crib and always keeps a jump ahead. Lots of other old-timers on the job, and young lads, too, doing a great job while they're waiting their draft calls.

"We've heard what you're doing, Ed. More power to you! Give 'em the works! And remember that inside those good American engines helping you, are Sealed Power Piston Rings and Pistons and Cylinder Sleeves made right, the way you'd make 'em yourself.

"So long for now, Ed. And good luck to you from the bottom of our hearts. Take care of yourself, boy, and come back to the job that'll be here for you."

SEALED POWER CORPORATION

Muskegon, Michigan • Windsor, Ontario



SCRAP METAL
IS NEEDED FOR
EVERY GUN,
TANK AND
SHIP. SEND
YOUR SCRAP
TO WAR.

PISTON RINGS — PISTONS — CYLINDER SLEEVES

Automotive and Rubber Industries Still Hampered by Wildcat Strikes


More 'Unauthorized' Strikes Causing Work Stoppages than at Any Time Since Pearl Harbor

Most serious outbreak of wildcat strikes since Pearl Harbor has plagued the automotive and rubber industries of late, causing work stoppage in a score of plants and tying up the production of vital war materials. Union politics, slowness in settling disputes by the War Labor Board, dissatisfac-

tion with grievances procedure and protest over a WLB wage decision all figured in the walkouts, which were marked by a general disregard for the authority of top rank union officers and in some cases of local officers and shop stewards. International officers of the UAW-CIO and of the United Rub-

ber Workers of America pleaded with strikers by radio, sound truck and through the newspapers to end the unauthorized walkouts and not violate the CIO's no-strike pledge but in most cases they did not go back to work until federal authorities intervened. In many cases union members booed their own officers at meetings and flaunted their advice about returning to their jobs. A breakdown of union discipline was evident. In the past the UAW-CIO has been reluctant to punish leaders of wildcat strikes generally for political reasons, and this laxity apparently is proving a boomerang.

Largest walkouts involved seven Detroit plants of the Chrysler Corp., where 29,000 employees were idle for (Turn to page 64, please)



Three interchangeable center pieces for all kinds of centered and uncentered work.

"Triple-Duty"

WITH **IDEAL**

"Triple-Duty"

LIVE CENTERS

- 1—Take Heavier Cuts
- 2—Turn at Higher Speeds
- 3—Save Cost of Fast Wearing Dead Centers

Get more work, faster work out of lathes, millers, grinders, etc., with IDEAL Live Centers. They rotate with the work, permit heavier loads—faster speeds—deeper cuts. Highest precision bearings are used—ball bearings for radial load, tapered roller bearing for thrust load. All parts are hardened and ground.

IDEAL METAL ETCHER

Permanently marks Tools, Parts, Dies, etc. This new IDEAL All-Purpose Etcher permanently marks smooth-surfaced iron, steel and their alloys. 14 Heats. Etches legibly, easily, permanently regardless of the hardness of the metal. Convenient ground clamp for etching large heavy parts and castings.



IDEAL DEMAGNETIZER

Quickly demagnetizes work held in magnetic chucks, tools, drills, punches, dies, etc. Chips disappear after a single pass across the magnetic poles. For small tools or large parts. Demagnetized tools cut faster because they do not bind, heat or dull quickly. Two sizes.



FREE

Machine Tool Accessory Catalogue gives information on these and many other time-saving tools.

IDEAL COMMUTATOR DRESSER CO.

3000 Park Avenue

Sycamore, Illinois

Sales Offices in all Principal Cities
In Canada: Irving Smith, Ltd., Montreal, Quebec

Business in Brief

Written by the Guaranty Trust Co., New York, Exclusively for AUTOMOTIVE AND AVIATION INDUSTRIES

Recent expansion of general business activity has been well sustained. The seasonally adjusted index of *The New York Times* for the week ended May 29 was 140.7 per cent of the estimated normal, as compared with 141.1 for the preceding week and the peak figure of 141.6 recorded for the second week of the month.

Department store sales during the week ended May 29, as reported by the Federal Reserve Board, were 42 per cent above the corresponding level in 1942. For the period of four weeks then ended, the total was 21 per cent greater than a year ago; and for 1943 to date sales have registered a comparable increase of 13 per cent.

Railway freight loadings during the week ended May 29 totaled 852,518 cars, 1.1 per cent more than in the week before and 7.2 per cent above the number a year earlier.

Electric power output during the same period declined less than seasonally and was 20.1 per cent greater than a year ago, as against a similar excess of 18.1 per cent a week earlier.

Crude oil production in the week ended May 29 averaged 3,970,300 barrels daily, 35,450 barrels below the figure for the preceding week and 327,100 barrels less than the output recommended by the Petroleum Administration for War.

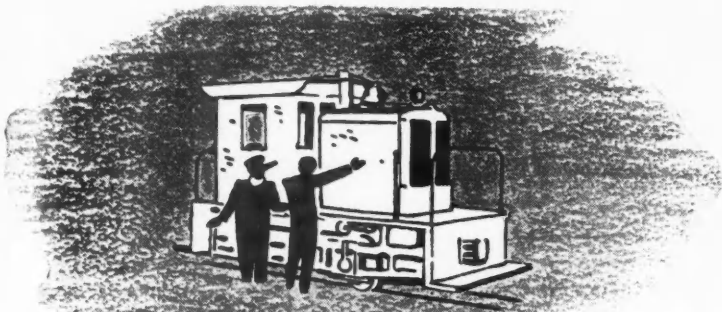
Average daily production of bituminous coal in the same period was 1,967,000 tons, as compared with 1,928,000 tons for the week before and 1,945,000 tons a year ago.

Engineering construction contracts awarded during the week ended June 3 amounted to \$106,873,000, the highest weekly figure since last November, but were 61 per cent below the corresponding total in 1942, according to *Engineering News-Record*. For the current year to date a similar decline of 60 per cent is shown.

Professor Fisher's index of wholesale commodity prices for the week ended June 4 rose one fractional point to 112.3 per cent of the 1926 average, as against 106.7 a year ago.

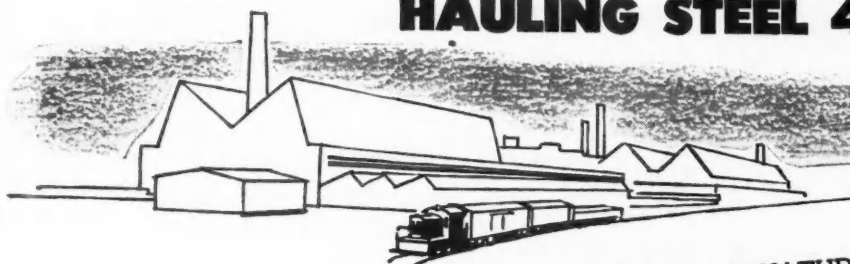
Member bank reserves increased \$219,000,000 during the week ended June 2, and estimated excess reserves rose \$130,000,000 to a total of \$1,630,000,000. Business loans of reporting members declined \$33,000,000 in the preceding week and stood \$1,045,000,000 below the total a year earlier.

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sidetracked **AT NOON**

HAULING STEEL 48 HOURS LATER



STEEL HAULING STOPPED WHEN MOTOR ARMATURE IN 15-TON LOCO-
MOTIVE FAILED. ARMATURE DELIVERED TO WESTINGHOUSE DISTRICT
MANUFACTURING AND REPAIR PLANT SAME EVENING. COMMUTATOR
WAS DISMANTLED, V-RING MACHINED AND REBUILT. BARS CUT BACK
AND NEW V'S MACHINED. MOTOR ASSEMBLED AND BACK IN LOCOMO-
TIVE—HAULING STEEL 48 HRS. LATER.

Westinghouse

DISTRICT MANUFACTURING AND REPAIR

J-90465



**IF THE EQUIPMENT NEEDING REPAIR IS
VITAL TO THE WAR EFFORT . . . PHONE
THE NEAREST OFFICE OF WESTINGHOUSE
ELECTRIC & MANUFACTURING COMPANY FOR**

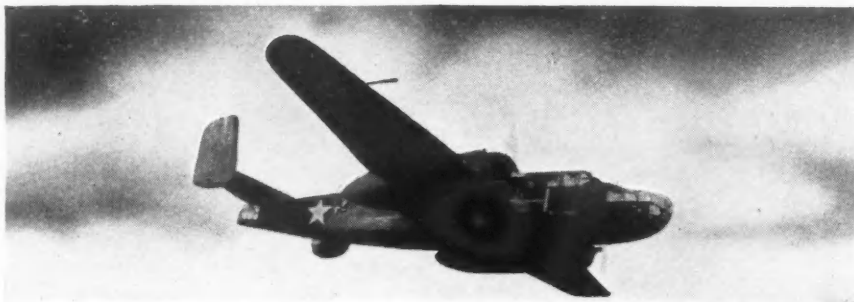
EMERGENCY SERVICE

33 M & R PLANTS . . . ONE NEAR YOU!

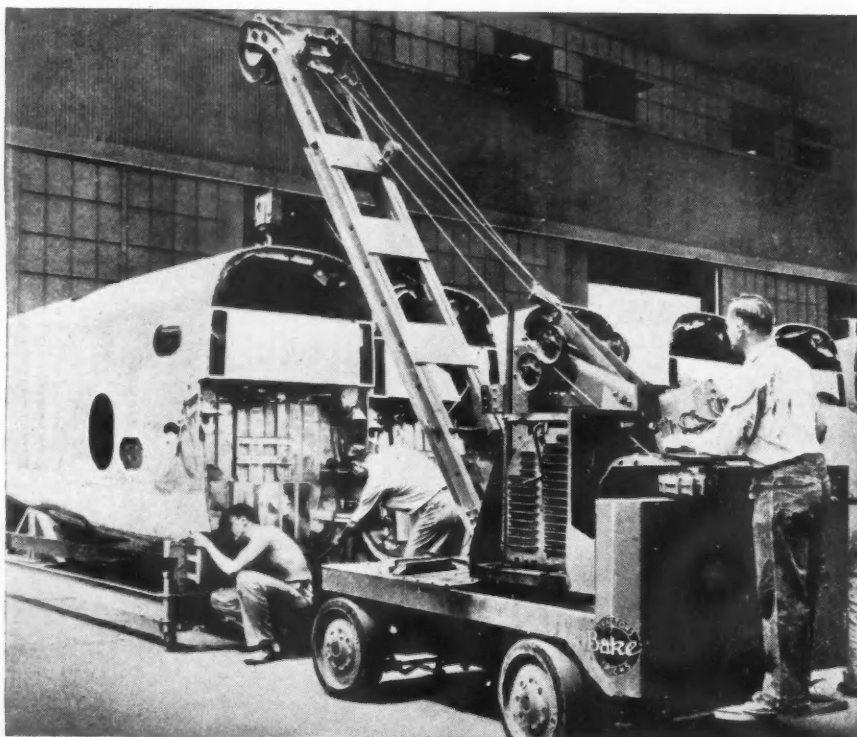


June 15, 1943

When writing to advertisers please mention **AUTOMOTIVE and AVIATION INDUSTRIES**



North American speeds airplane assembly with **BAKER TRUCKS**



● The versatility of the Baker Crane Truck is demonstrated by North American Aviation, where it speeds many assembly operations on the B-25 Bomber and the P-51 Mustang Fighter. Among the services it performs are moving fuselages into assembly positions, assisting in the installation of engines and propellers,

and general heavy duty around the plant. North American also uses Baker Hy-Lift Trucks for handling heavy dies.

Baker Trucks are contributing to war production in hundreds of other plants. A Baker Material Handling Engineer will be glad to show you how our equipment may solve your problems.

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Baker INDUSTRIAL TRUCKS



Awards

Names of winners of Army-Navy "E" awards in or allied with the automotive and aviation industries, announced since the June 1 issue of *Automotive and Aviation Industries* went to press.

AMERICAN CYANAMID COMPANY (two plants).
BERRY BROTHERS, Detroit, Mich.
BRIDGEPORT BRASS COMPANY, Indianapolis, Ind.
BROWN STEEL TANK COMPANY, Minneapolis, Minn.
CHAMBERSBURG ENGINEERING COMPANY, Chambersburg, Pa.
CINCINNATI BALL CRANK COMPANY, Cincinnati, Ohio.
THE CLEVELAND TRACTOR COMPANY, Cleveland, Ohio.
CURTISS WRIGHT CORPORATION, Propeller Div., Beaver, Pa.
DEERE AND COMPANY, Moline, Ill.
DELTA OIL PRODUCTS COMPANY, Milwaukee, Wis.
ERIE FOUNDRY COMPANY, Erie, Pa.
EVANSVILLE ORDNANCE PLANT (Chrysler Div.), Evansville, Ind.
EVANSVILLE ORDNANCE PLANT (Sunbeam Div.), Evansville, Ind.
FORT PITT BEDDING COMPANY, Pittsburgh, Pa.
GUSTIN-BACON MFG. COMPANY (two plants).
JONES AND LAUGHLIN STEEL CORP., Pittsburgh, Pa.
LEBANON STEEL FOUNDRY, Lebanon, Pa.
LINK-BELT COMPANY (two plants).
MALL TOOL COMPANY, Chicago, Ill.
THE METAL SPECIALTY COMPANY, Cincinnati, Ohio.
NATIONAL MALLEABLE & STEEL CASTINGS CO., Indianapolis, Ind.
PHILADELPHIA GEAR WORKS, INC., Philadelphia, Pa.
PITTSBURGH ELECTROMELT FURNACE CORP., Pittsburgh, Pa.
QUALITY TOOL AND DIE CO., Indianapolis, Ind.
THE RESINOUS PRODUCTS AND CHEMICAL CO., Philadelphia, Pa.
REVERE COPPER & BRASS, INC., Baltimore, Md.
UNITED STATES RUBBER CO., Eau Claire, Wis.
WALD MANUFACTURING CO., INC., Maysville, Ky.
THE WAYNE PUMP COMPANY, Fort Wayne, Ind.
WESTERN MACHINE TOOL WORKS, Holland, Mich.
WESTINGHOUSE ELECTRIC & MANUFACTURING CO., Mansfield, Ohio.
WORCESTER PRESSED STEEL COMPANY, Worcester, Mass.

Sunlight Electrical Division of GM Merged

Sunlight Electrical Division of General Motors Corp. has been merged with the Packard Electric Division, effective July 1, with the latter name retained for the combined divisions. Both are located at Warren, Ohio. B. N. MacGregor will continue as general manager of Packard Electric, while J. B. Estabrook, formerly general manager of Sunlight Electrical, will be special assistant to MacGregor.

Here at last . . . the answer to Corrosion Problems

ANTI-CORRODE

New Liquid Safeguard Developed by Cities Service

Anti-Corrode, Proved Perfect by Months of Laboratory Testing, Meets Severest Corrosion Requirements. It's Easy, Economical to Apply.

After months of laboratory research and rigorous service tests, Cities Service takes pride in announcing the development of a new and completely effective corrosion preventive—Anti-Corrode.

This new liquid safeguard, by virtue of its special properties, and its reasonable cost, is hailed by many engineers as a perfect answer to the vital problem of metal conservation that American industry faces today.

METHODS OF APPLICATION

Anti-Corrode can be applied to raw stocks, finished parts, or to complete machines during storage, assembling or shipping. It is easily applied by dipping, brushing, rubbing, hand or power spraying—and provides a safe film which does not harden, become brittle or crack.

WEATHERING

Anti-Corrode is not affected by rain, salt air, oxygen bearing moisture, etc.

ODOR

Anti-Corrode has no disagreeable odor.

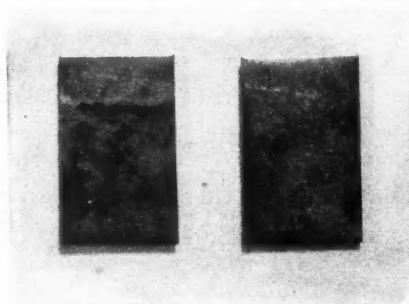
CHEMICALLY INERT

Anti-Corrode is chemically inert to ferrous or non-ferrous metals. Therefore, it can cause no injury to any metal to which it is applied or with which it may be brought in contact.

FINGER STAINS

Surfaces coated with Anti-Corrode can be handled freely without danger of rust spots caused by hand acid.

ANTI-CORRODE MEETS U. S. NAVY TEST



BOTH STRIPS of freshly ground steel pictured here were immersed for 20 hours in a 3% salt solution. Strip on left was untreated; strip on right, coated with Anti-Corrode, shows no trace of rust. (Even after 90 hours of immersion Anti-Corrode coating still resisted rust.)

A LUBRICANT, TOO

Anti-Corrode is compatible with drawing compounds; there is no need to remove it from

metal about to be drawn, stamped or otherwise formed.

IDEAL FOR MANY USES

Anti-Corrode can be used on almost every kind of metal or metal equipment—indoors or outdoors. Fencing, piping, tubing, wire, wire mesh, girders, sheet metal, metal stock, machinery, trucks, spare automotive parts, tools, metal containers—all need the protection of this new corrosion preventive.

ECONOMICAL

In accordance with regular U. S. Navy Test procedure, Anti-Corrode proved far superior to other leading anti-rust compounds costing as much as 25% to 40% more per gallon.

Whatever metal equipment you may have, you owe it to yourself to investigate the money-saving advantages of Cities Service Anti-Corrode. (One gallon of Anti-Corrode protects approximately 1200 square feet of sheet metal.) Send the coupon below for further information on how to obtain an adequate sample of Anti-Corrode FREE.

CITIES SERVICE OIL COMPANY

Room 1635,
Sixty Wall Tower, New York.

Gentlemen: I'd like to test Anti-Corrode on my own equipment FREE OF CHARGE. Send me the details.

Name.....

Title.....

Company.....

Address.....

OIL IS AMMUNITION—USE IT WISELY!



Safer Method of Teaching Blind Flying

A new method of teaching and practicing blind flying in daylight has been developed which assures maximum safety. The equipment is extremely simple and consists of but two things, green transparent Lumarith plastic sheeting that is easily attached to the cockpit windows, and a pair of red transparent Lumarith plastic goggles that are worn by the student pilot, but not by the instructor. When the student puts on the red goggles, he can see his instrument panel and everything within the plane but he cannot

see through the green Lumarith sheeting across the windows because the effect is opaque and he merely sees black. In other words he is flying blind. The instructor on the other hand who wears no goggles, can see everything within the plane and also can see outside clearly through the green Lumarith.

The advantages are apparent. The instructor is able to see plainly the movements of the student and make his corrections; at the same time he can constantly check the plane's course against land marks and spot terrain elevations. It eliminates the hazards that accompany the old method of hav-

ing even the instructor partly or wholly blind because of heavy curtains and hoods. The green sheeting is so easily attached and removed that training planes can be released at any time for other service.

Obituary

Don P. Molony, 55, an executive of the Delco-Remy Division of General Motors, died May 28 at Anderson, Ind., after a long illness. He started with Continental Motors Corp. in 1909 and in 1913 joined the Marvel Carburetor Co., Flint. From 1932 to 1939 he was vice president of the Marvel-Schebler Carburetor Division of Borg-Warner Corp. He was assistant to the president of Pierce Governor Co. from 1939 to September, 1942, when he joined Delco-Remy.

George L. Grimes, 67, owner of the Grimes Moulding Machine Co., Detroit, died May 28 at his home in Detroit after a short illness. He helped design the first castings on moulding machines for multiple production for the Ford Motor Co. and also made notable foundry installations at the Buick Motor Division of GM and the Dow Chemical Co.

Ralph P. Lyons, former treasurer of the Hupp Motor Car Corp., died May 29 at his home in Fowlerville, Mich. He was associated with Hupp from 1908 to 1934, being a director as well as treasurer. Later he was with Briggs Mfg. Co.

Harry F. Plagenz, vice president and treasurer of The Cuyahoga Spring Company, died May 21.

Rohm & Haas Opens New Plastics Plant

Opening of a new plastics plant which will quadruple the production of Plexiglas sheets for bomber noses, gun turrets, astro domes, and other transparent plane enclosures was announced by Rohm & Haas Company, Philadelphia, Pa.

Located in Knoxville, Tennessee, inland from both coasts and borders, with an ample available local labor supply, the plant utilized mostly second-hand equipment when new, tailor-made furnishings could not be found immediately, even with top priorities.



E F Gas Fired Continuous Chain Belt Conveyor Type Furnaces for

Scale-Free Hardening Small Parts

Bolts, Springs, Bearings and Other Products

--300 to 1700 lbs. per Hour

The above E F gas fired furnace installation is one of several similar installations we have made for scale-free hardening bolts. E F Continuous Chain Belt Conveyor Type Furnaces are handling all kinds of products ranging in sizes from small springs and machine gun cartridge clips up to large crawler links for tanks and tractors. Hundreds of these furnaces are in operation.

The material is loaded directly onto rugged heat resisting cast link belt conveyors. Without further attention, it is carried through the furnace, uniformly heated to the proper temperature and automatically discharged through a sealed chute to the quenching medium or directly from the furnace as desired. The chain belt conveyor returns within the furnace without cooling—no pans or trays are used in the furnace—100% net material.

These furnaces are built for oil, gas or electric heat in five standard sizes with capacities ranging from 300 to 1700 lbs. per hour. Larger or smaller sizes can also be furnished. They are also designed for using special protective atmospheres for scale-free heat treating and hardening without decarburization.

The hundreds of installations in operation, handling all kinds of material, have proven the continuous type furnaces the most satisfactory and dependable general purpose heat treating machines built for the uniform, economical, continuous production heat treatment of miscellaneous small and medium-sized parts and products.

The Chain Belt Conveyor Furnace is only one of the numerous types we build for various heat treating purposes.

Tank armor castings, shell forgings, cartridge cases, bomb and gun parts, aircraft and aircraft engine parts, and many other allied products are being uniformly treated in outstanding production furnaces built by the Electric Furnace Company, Salem, Ohio. We specialize in designing and building production furnaces.

Send for circulars showing these and other types of E F Production Furnaces

The Electric Furnace Co., Salem, Ohio

Gas-Fired, Oil Fired and Electric Furnaces—For Any Process, Product or Production

CALENDAR

Conventions and Meetings

Automotive Engine Rebuilders Assoc., Cincinnati	June 15-17
SAE Nat'l Tractor Mtg., Milwaukee, Sept. 23-24	
SAE Nat'l Aircraft Engineering & Production Mtg., Los Angeles, Sept. 30-Oct. 2	
National Safety Congress, Chicago.	Oct. 5-7



Here's What You're Fighting For . . .

. . . your way of life! Every man interprets it a little differently, but to us all it means a car, a radio, a refrigerator; the right to those things that make our daily life pleasanter, more convenient, more exciting. Today Weatherhead plants are producing vital parts for planes, tanks, ships, trucks and munitions at the rate of *millions every twenty four hours*. The coming of Peace will find us prepared to join with you in building the durable goods all the world will want from America as well as many strange new devices that are even now being born in the war.

Look Ahead with



Weatherhead

THE WEATHERHEAD COMPANY, CLEVELAND, OHIO

*Manufacturers of vital parts for the automotive, aviation,
refrigeration and other key industries.*

Branch Offices: Detroit, Los Angeles, New York and St. Louis

PUBLICATIONS

The Weatherhead Co. has published a new 8-page **Catalogs Supplement** showing its products together in one publication. It is published for the convenience of engineering, production, designing and purchasing departments.*

United States Rubber Co. has announced the publication of a new booklet containing technical data and engineering information on its line of **Royal airplane tires**. Included in the booklet is a complete description of airplane tire dimensions, tire and rim measurements, weights, non-skid contact area figures, etc. Sections are devoted to airplane tubes and tire valves

and charts showing load deflection curves for smooth contour, high pressure, low pressure and profile nose wheel tires. Please use your company letterhead when requesting copy.*

Manganese Steel for General Industry is the title of a new booklet published for general industrial circulation by the American Manganese Steel Div. of American Brake Shoe Co. It is booklet No. 543-G.*

Sterling Varnish Co. has issued Bulletin No. 143 entitled **Thermobonds, The New Insulation**. Thermobonds are produced for application to such units as high speed armatures, high cycle drill and grinder motors, heavy duty motors, transformers, etc.*

George Gorton Machine Co. has issued a new booklet describing and illustrating its new **Gorton 16-A Precision Automatic Screw Machine**. Information is also given

regarding attachments for the machine and complete specifications.*

A new 32-page **cemented carbide die manual and catalog**, covering standard and special dies for drawing wire, bar, tubing and sheet metal has just been issued by Carboloy Co., Inc.*

New catalog sections have been published by Whiting Corp. covering various Whiting developments for the aircraft industry. They are, Model BT Brake Tester; Model E5 Multi-Purpose Assembly Stand; Cargo Handling Equipment; Propeller Handling Equipment and Engine Stands.*

Airplane Power, with special reference to engines and altitude, is the title of a new brochure in the series of non-technical booklets issued by General Motors Corp. This booklet covers the fundamentals of engine and airplane performance at various altitudes, with an important commentary on supercharging.*

Facts About Small Fine Pitch Hobs is the title of a new booklet published by Barber-Colman Co. The information contained in the booklet is offered for convenience in better understanding the problems of producing and using these hobs in a way which will provide the utmost in accuracy and production.*

A new booklet on **Mot-O-Trol Drive**, an electronic adjustable-speed drive, has been issued by Westinghouse Electric & Mfg. Co. The booklet is illustrated, tells how Mot-O-Trol works and lists its advantages.*

Titeflex Metal Hose Co. has issued a new catalog, No. 113, which gives the general industrial applications of its line of **flexible metallic tubing**. It contains complete pressure charts, charts showing radius of bend and other essential data.*

Metallizing Co. of America has published a new bulletin describing its **Mogul Electric Bonder**, a unit for preparing hardened metal surfaces for metallizing. The bulletin also gives specifications, prices and other information on this unit.*

*Obtainable through Editorial Dept., Automotive and Aviation Industries, Chestnut and 56th Sts., Philadelphia. In requesting any of these publications, please give date of issue, your company connection, and position.

Aircraft Fasteners Division Established

In the last few months there has been a great increase in the number of matters relative to aircraft fasteners that have been taken up with this organization by various interested people. Requests for information or cooperation have come from the Interdepartmental Screw Thread Committee, Army-Navy Aeronautical Board, Wright Field, Army-Navy Air Corps, Society of Automotive Engineers, and the War Production Board, as well as many aircraft manufacturers.

In order that the Institute might be of help in these matters in a more adequate way and with more assurance, the members of the Institute have authorized the setting up of an Aircraft Fasteners Division of the Institute to function for them in aircraft products in the same general way as carried on heretofore in connection with other products of the industry. Messrs. H. O. McCully (Chmn), Russell, Burdsall & Ward B&N Company, J. W. Fribley, Cleveland Cap Screw Company, A. M. Jones, Buffalo Bolt Company, and C. F. Newpher, National Screw & Mfg. Company, were appointed as a committee to establish this Division.



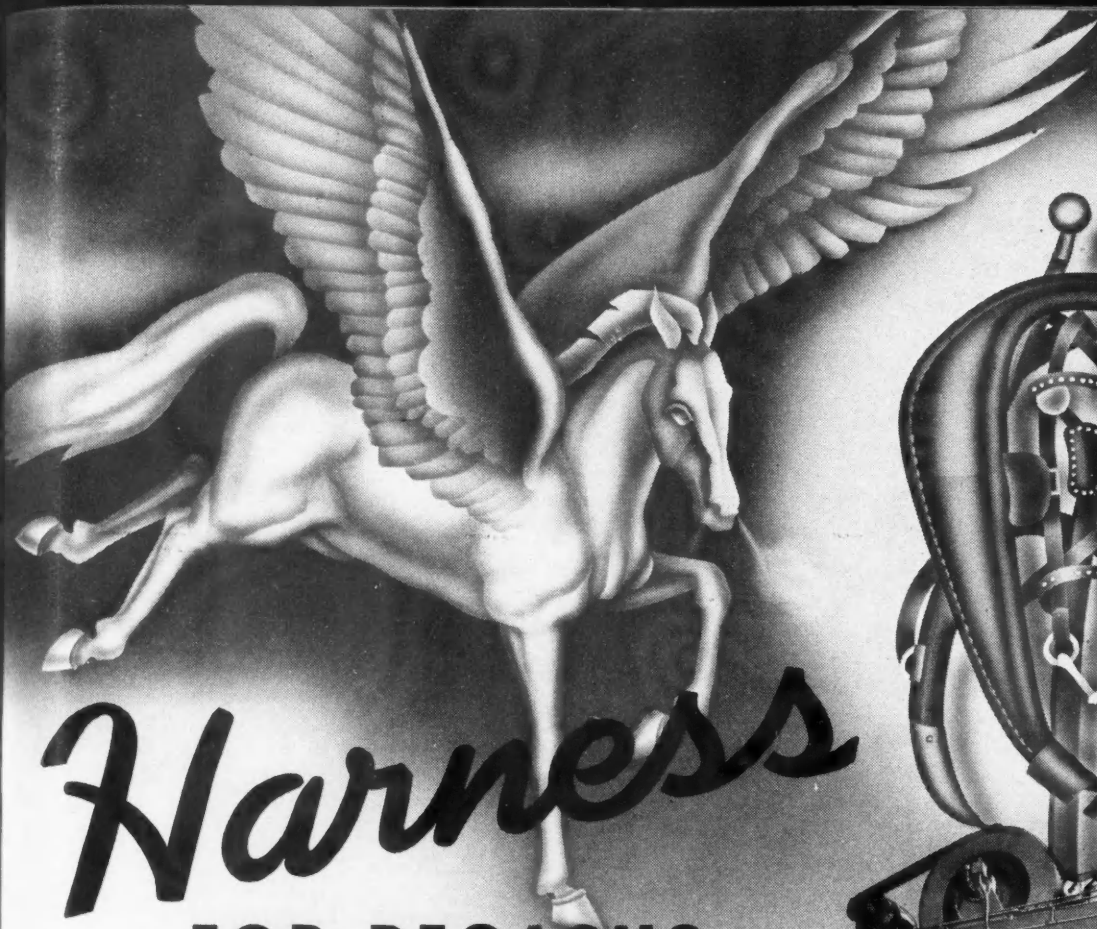
**FLYING
STEEL**

From Atlas in the Army
and Navy's greatest bombers
softens up the tough spots in
Axis resistance and makes
the way easier for Allied
armies all over the world.

ATLAS DROP FORGE COMPANY
LANSING, MICHIGAN

ATLAS
DROP FORGINGS





Harness

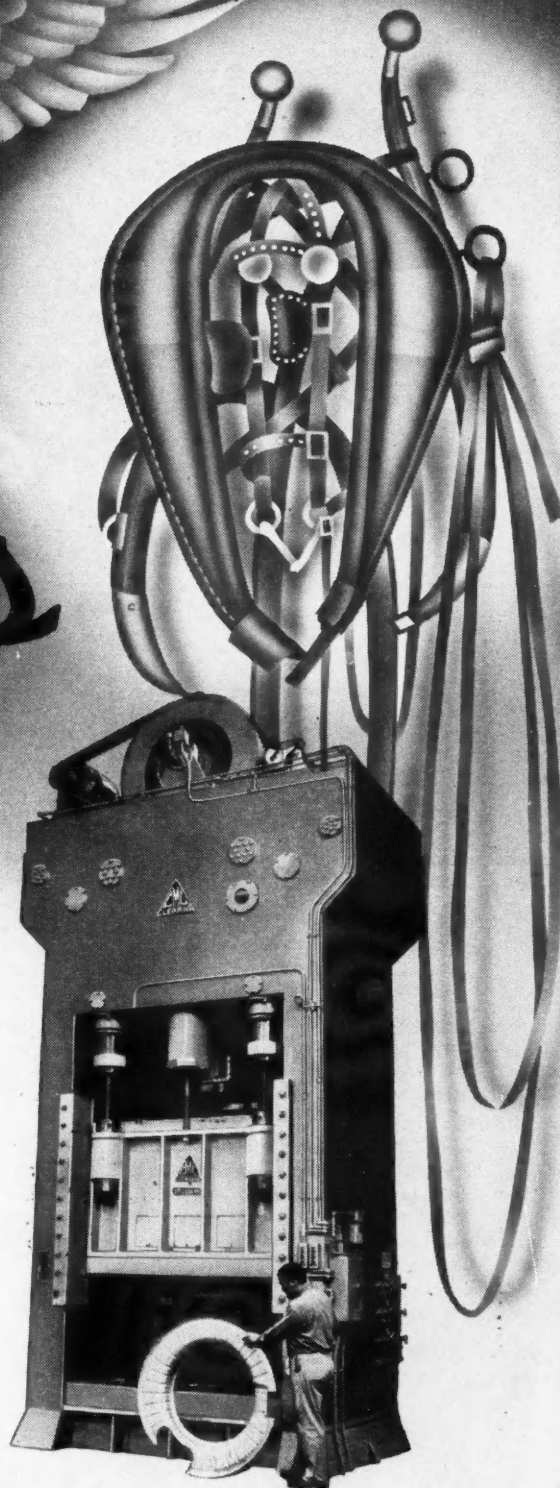
FOR PEGASUS

Pegasus, winged horse of ancient mythology, has long represented the free flights of fancy indulged by poets and dreamers. But Pegasus finds himself in harness now — a practical, workaday harness, indeed.

Engineers and designers everywhere have permitted themselves to dream as never before, yet ways have been found to make those flights of fancy carry real pay loads. Clearing presses are producing parts for some amazing products — often by procedures which only yesterday would have been called impossible.

Clearing ingenuity, skill and facilities, and Clearing experience are at your service as you plan your products for a future market. Whatever the shape of things to come from your plant, whatever their materials, Clearing presses can probably help you to faster, lower cost production. Let us help you fashion a harness for your own Pegasus.

CLEARING MACHINE CORPORATION
6499 W. 65th Street, Chicago, Illinois



The forming of Venturi rings for engine cowling assemblies is one of the jobs assigned to this double action 350-ton capacity Clearing Mechanical Press—installed at one of the plants of the Douglas Aircraft Company, Inc.



FOR SHAPES OF THINGS TO COME

CLEARING

MECHANICAL AND HYDRAULIC PRESSES

**PILOT GETS
INSTANT
RESPONSE**

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ELECTRIC HYDRAULIC VALVES

hi-g hydraulic controls give instant positive action in propeller feathering, wing flap and landing gear, temperature flaps, anti-icing and many other plane operations.

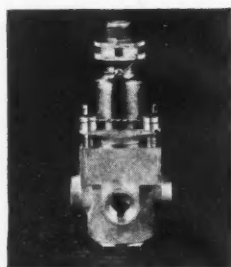
They are unaffected by vibration, change of motion and operate in any position. These two-wire valves are compact and light in weight. Available normally open or closed, they handle all fluids, vapors and gases up to 3000 lbs. or more.

hi-g controls are designed for continuous or intermittent duty. 3 or 4-way types are for hydraulic control, provide proportioning, inching or complicated selector valve arrangements. Write for the **NEW BULLETIN** describing our complete line of electric valves for aircraft.

***TRADE MARK**—**hi-g** indicates positive ability to operate in any position, regardless of vibration, change of motion or acceleration.



Type AV-14; hydraulic selector valve.



Type AV-11; 3-way hydraulic control.

GENERAL  CONTROLS

**PIONEERS AND LEADERS IN THE DEVELOPMENT
AND MANUFACTURE OF MAGNETIC VALVES**
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Curtiss-Wright's New Research Laboratory

(Continued from page 39)

veloped as the physics section. The east wing provides an area for printing and duplicating work, stationery storage, and space for stacks of the library. The two-story office section, of some 7500 sq ft, fronts the laboratory as an integral unit and houses executive and administrative personnel and the library. Shortage of critical materials caused the laboratory to be a reinforced concrete job with brick veneer and cinder block walls. The peculiar demands of the wind tunnel resulted in some very unusual and out of the ordinary framing for the concrete in this area.

In the laboratory proper the east end of the building is devoted almost entirely to activities related to the wind tunnel. A wood and machine shop in this area is devoted mainly to model making, but it also makes the special gadgets for all departments of the laboratory. The receiving and shipping functions of the laboratory also find space in the first floor of the east wing. The second floor of this area is occupied by sections for drafting, computing and model preparation, and by the control room proper of the wind tunnel.

The west end of the laboratory is given over mainly to static test work. The main section for this work is 50 ft wide, 140 ft long and 35 ft high, and is winged by a space 40 by 40 ft with a removable second floor, so that a ship of the Commando class can be tested as a complete assembled unit. This main section is served by a 10 ton crane. Across the main span a special steel support will allow a loading of 300,000 pounds to be made. Throughout the entire area are located hold down bolts on five-foot centers, each capable of 25,000 pound loadings. A steel back stop set in special concrete footings allows accurate cantilever studies to be made up to ten million inch-pounds. Repeated load and strength testing machines are located on the first floor adjoining this area. Here too is located the altitude chamber with its 70 tons of special steel shells and equipment, which will take entire fuselages and personnel down to temperatures colder than the stratosphere, and to vacuums comparable to 40,000 ft heights. Three-stage Freon compressors, centrifugal vacuum pumps, economizers, dehumidifiers and auxiliary pumps are located adjacent to the chamber.

On the first floor of the center of the laboratory there is a section given to the study of wood and plastics, and also one for hydraulics, each with the necessary special testing equipment. On the second floor this center section is taken by studies on heat transfer, by the electrical testing laboratory, and by special welding equipment. The second floor in the west wing of the building is devoted to drafting and computing, studies on vibration and flutter, and to chemical and metallurgical laboratories which have facilities for organic and inorganic studies, X-rays, photo-elastic work, dark rooms, etc.

The floor space of the areas now occupied consists of some 63,000 sq ft. Ground has now been broken for the foundations of the wind tunnel, both the housing of the test section and the power area. This will bring the total space contemplated up to approximately 80,000 sq ft. It is expected now that this will all be completed by the fall of this year.

The laboratory is under the direction of Dr. Clifford Cook Furnas, chemical engineer, and formerly a professor at Yale, who is a member of the National Defense Research Council in Washington. His staff now numbers over 150 specialists in the fields of aviation research.

BUY MORE WAR BONDS

KEEP THE SABOTEURS OUT



DUST and DIRT, the most destructive saboteurs that ever attack a bearing, can be effectively excluded by the use of Chicago Rawhide "Perfect" oil seals. At the same time these seals prevent the leakage of lubricant. Thus they constitute the best available insurance of long serviceable bearing life.



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64 Years Manufacturing Quality Mechanical Leather Goods
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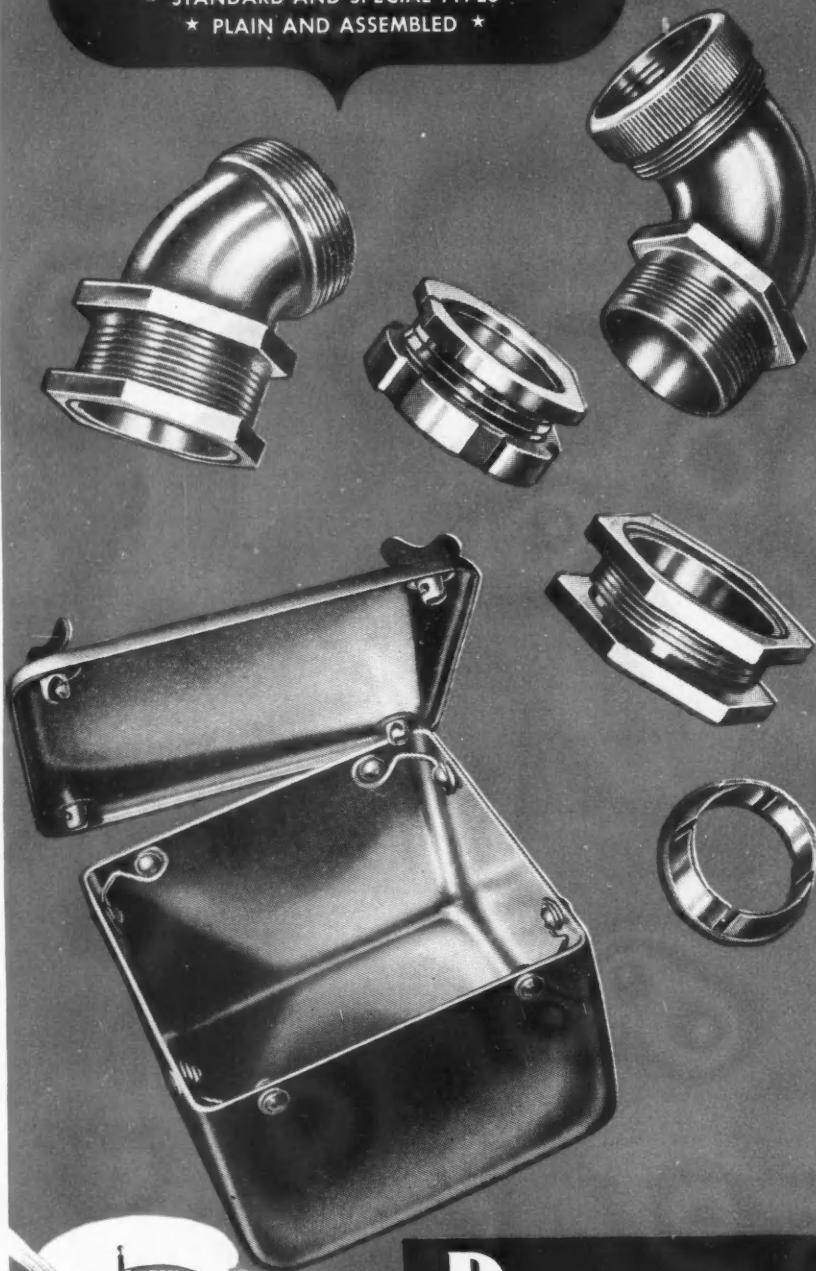
★ **NOW in Mass Production** ★
CONDUIT FITTINGS

★ TO ARMY AND NAVY SPECIFICATIONS ★

JUNCTION BOXES

★ STANDARD AND SPECIAL TYPES ★

★ PLAIN AND ASSEMBLED ★



**POULSEN
 & NARDON,
 INC.**

LOS ANGELES • CALIFORNIA

ESTABLISHED
 1922

100,000 Airplanes Since June, 1940

(Continued from page 48)

crease is even sharper—from 14 per cent of 1942 production to only 4 per cent of 1944 schedules."

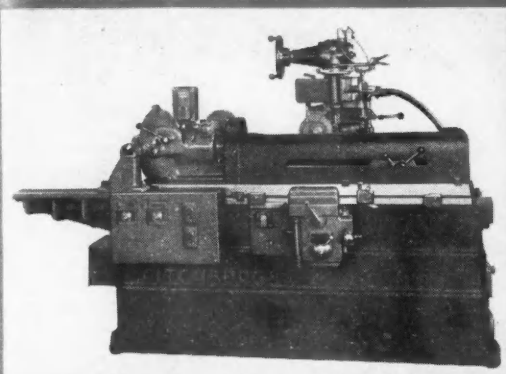
Wilson said that the new Bell Bomber plant at Marietta, Ga., "another Willow Run in size," would be in partial production this fall and in good heavy production by the spring of 1944. It is destined to build some of the new super-bombers. The WPB executive said there were no serious bottlenecks in fundamental plane parts, such as propellers, engines or airframes, but there are serious minor bottlenecks in forgings and extrusions.

Chevrolet Motor Division of GM is helping overcome this bottleneck in aluminum forgings, already operating three new forge plants and preparing a fourth for such production. A former spring and bumper plant at Saginaw is producing pistons for military engines. A new forge plant also has been built at Saginaw and has been in production six months on propeller blades for four manufacturers, crankcase sections and covers for Chevrolet-built Pratt & Whitney aircraft engines, propeller hub pistons and other aircraft items. This plant supplies more than a dozen prime contractors in addition to Chevrolet. Equipment includes four 35,000-lb steam hammers, 10 smaller hammers, upsetters, heat treating furnaces and a 3000-ton hydraulic press used to cog down 1500-lb aluminum ingots. A transmission forge plant at Muncie also has been converted to aluminum forgings for aircraft parts. Part of Chevrolet's Saginaw grey iron foundry has been converted to the manufacture of magnesium castings, eight parts for Chevrolet P & W aircraft engines being cast there. This plant still produces cast iron parts for aircraft, tanks, guns and military trucks, too.

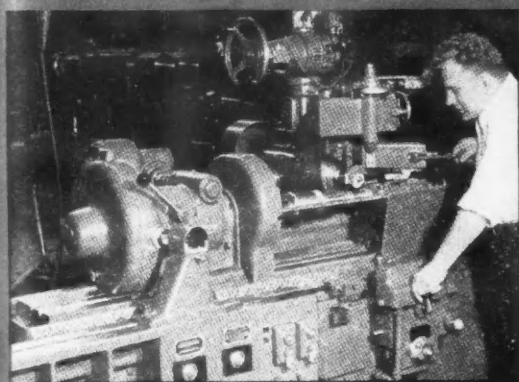
The fluidity of warfare probably is responsible for the fact that two manufacturers, Baldwin Locomotive Works in Philadelphia and American Locomotive Co. in Schenectady, N. Y., are being taken out of tank production and converted back to producing locomotives for lend-lease. Maj.-Gen. L. D. Clay, director of materiel for the Army Service Forces, said the change was being made at the request of one of the U. S. major foreign customers, which canceled its entire requirements for tanks and combat vehicles and asked for railway equipment instead. This customer probably is Russia, which had received 6200 tanks from the U. S. and Great Britain up to March 1 and which was the recipient of 38 per cent of the tanks exported under lend-lease by the U. S. in the two years ending March 31. Russia needs the railway equipment for areas devastated by the Nazis and now recaptured. Gen. Clay figured the reconversion to locomotives can be made in six or seven months.

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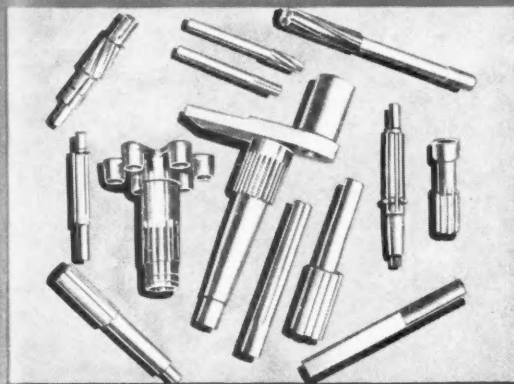
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*Automatic Closed
Cycle Grinding . .*



FITCHBURG SPLINE GRINDER



GRINDING SPLINES ON WRIGHT AIRPLANE CRANKSHAFTS



EXAMPLES OF WORK GROUND ON FITCHBURG SPLINE GRINDER

The Fitchburg formed wheel grinding method, with automatic closed cycle, produces a wide variety of splines for automotive, airplane and marine industry with fine finish, accuracy and high speed. This results in smoother product performance.

Here are some of the outstanding features of the Fitchburg Spline Grinder:—

These machines are designed so that new operators can be trained quickly to operate them — an important factor in these times.

Wheelhead column may be arranged to swivel to a maximum of 20 degrees for either right-hand or left-hand helical lead angle when helical attachments are furnished.

Elevating mechanism is mounted on top of the column for the convenience of the operator.

The headstock may be furnished for either straight, right-hand, or left-hand helical splines.

The index plate is mounted at the left-hand end of the headstock so that it may be removed easily for changing plates. There is a standard 16 key plate which will take care of 2, 3, 4, 6, 8 and 12 spline shafts by inserts in the index notches. Separate index plates are necessary for other spline divisions.

Many leading industrial plants in the United States are using Fitchburg grinding equipment to speed production and save man hours. Let Fitchburg engineers show you how to speed production by this modern grinding method.

Write today for this catalog showing wide range of successful operations.



FITCHBURG GRINDING MACHINE CORP.
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Manufacturers of — Bowgage Wheelhead Units, Multiple Precision Grinding Units, Spline Grinders, Cylindrical Grinders, Gear Grinders, Bath Full Universal Grinders and Special Purpose Grinders.

MEN

Bendix Aviation Corp. has announced the election of **W. H. Houghton** as treasurer, and **Arthur E. Raabe** as vice-president and group executive.

F. M. Beauregard has been appointed works manager of Willys-Overland Motors. He was formerly general works manager of the Crosley Corp.

George O. Rowland, of The Osborn Mfg. Co., has been appointed chief of the War Production Board's industrial brush unit, Washington, D. C.

Floyd L. Wheaton has joined the staff of the Bendix-Westinghouse Automotive Air Brake Co., with headquarters at Elyria, Ohio. He will be manager of field activity.

He was formerly supt. of rolling stock for the Dept. of Street Railways, City of Detroit.

E. F. Nelis, of the Bendix-Westinghouse Automotive Air Brake Co. has been appointed manager of the company's retail sales department.

Ralph O. Proctor, who has been with the War Production Board for the past two years, has resigned to become chief field engineer and assistant to the general manager of the Malabar Machine Co., Los Angeles.

Bendix Aviation Corp. has announced the election of **Palmer Nicholls** as president of Bendix Aviation, Ltd., at North Hollywood, Calif.

Bert Conway, who has been with the General Motors Corp. for the past 22 years, has been named manufacturing coordinator for The Aviation Corp.

Ben O. Howard has been appointed assistant to Donald W. Douglas, president of Douglas Aircraft Co. He will be in charge of technical and flight problems.

James A. Mitchell has been elected vice-president and general manager of Timm Aircraft Corp., Los Angeles and Van Nuys, Calif.

Ira Stuart Wilson has been elected vice-president in charge of finance of Brewster Aeronautical Corp.

Westinghouse Electric & Mfg. Co. has announced the election of **Charles R. Hook** and **Elisha Walker** to the Board of Directors.

Richard D. LaFond has been appointed director of public relations, Sperry Products, Inc.

V. E. Blue, formerly employment supervisor of the Dodge Div. of Chrysler Corp., has been appointed to the staff of **C. T. Winegar**, director of personnel of the Corp.

E. P. Warner, of the Civil Aeronautics Board, has been made an Honorary Fellow of The Royal Aeronautical Society.

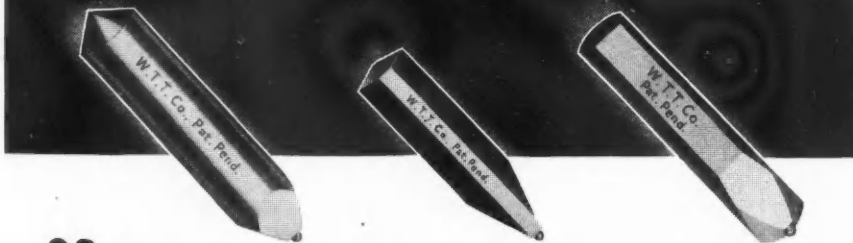
Carl A. Frische has been named chief research director of The Sperry Gyroscope Co., Inc. He succeeds **Hugh Willis**, who is now general sales manager of the company.

V. H. Peterson, formerly vice-president of the Elliott Co., has been appointed assistant to the president of The Baldwin Locomotive Works.

The Culver Aircraft Corp. has announced the appointment of **Charles M. Jamieson** to the position of chief engineer.

The appointment of **Alfred Marchev**, vice-president of Republic Aviation Corp. and general manager of its Farmingdale plant, to the position of executive vice-president, has been announced.

EXPERIENCE is a Great Teacher!



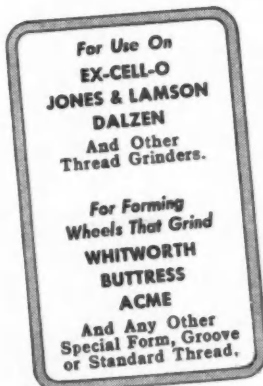
33 YEARS OF EXPERIENCE BACKS THE DEVELOPMENT OF THIS NEW TYPE THREAD GRINDING DIAMOND TOOL!

Here is a new type wheel dressing diamond tool that brings new standards of performance and economy to your thread grinding operations.

It gives better performance because it utilizes the hard characteristics of the natural uncut diamond—and yet it is of a shape that permits not only straight dressing but angle, radial and multiple form dressing as well.

It gives greater economy because its cleaner cuts mean forms are obtained quicker and hold longer—fewer dressings are needed—more work can be ground between dressings—down time is greatly reduced—and because this precision tool can be made and reserviced on a production basis, quicker deliveries are assured.

And your assurance of satisfaction is the knowledge that back of this new type thread grinding diamond tool is the experience gained by a manufacturer who has spent the past 33 years building diamond tools of fine quality.



★ ★ ★
Try it and you'll agree . . .
there is no substitute for experience!

Available
ONLY
from

WHEEL TRUEING TOOL COMPANY

3200 W. DAVISON

DETROIT, MICH.

Wildecat Strikes Continue

(Continued from page 52)

four days, and four of the largest rubber companies in Akron, where 51,000 workers went on strike for five days. The Chrysler strike, although called a spontaneous protest by the workers over a breakdown in grievance procedure and failure of the company to observe seniority rules, started simultaneously in the Dodge Main, Chrysler-Jefferson and Kercheval plants, later spread to the Dodge Lynch Road and DeSoto Bomber plants, and then forced into idleness the Dodge Truck and Chrysler Tank Arsenal through lack of parts.

The Akron walkout started at the Goodrich plant and later spread to Goodyear, Firestone and to part of the General Tire & Rubber Co. It was in protest over a WLB ruling which allowed a 3-cent per hour general wage increase instead of the eight cents sought by the URWA. The board cut the amount to conform to the 15 per cent Little Steel formula and to prevent the unstabilizing of wage rates in the rubber industry. The case had been pending since June, 1942. It was made retroactive to May 28, 1942 for U. S. Rubber Co.; May 31, 1942 for Firestone; June 17 for Goodrich and July 1 for Goodyear. S. R. Dalrymple, president of the URWA, pleaded in vain for the strikers to observe their no-strike pledge and return to work. However, they did not end the strike until President Roosevelt sent a telegram to the union officers calling upon the workers to return to their jobs by noon of the following day or the government would take action.

From Studebaker to Cyclones

(Continued from page 35)

plement of heavy-duty single-spindle and two-spindle Baker drills, Natco single-spindle and multiple-spindle drills, Leland-Gifford drills and sensitive oil hole drilling machines. And, in addition, several Heald Bore-Matics and Bryant internal grinders for finishing trunnions on the pinion cage.

POLISHING DEPARTMENT—a number of polishing departments are found here, so located as to serve the finishing operations most economically. This work is done on benches equipped with suitable tools, and provided with the familiar Kellerflex portable tools for polishing and grinding and blending.

QUALITY CONTROL—this is, naturally, one of the most important functions in a gear plant. The usual facilities for hardness checking and for the gaging of dimensional tolerances are provided. However, these are supplemented by a comprehensive gear laboratory equipped with special instruments for checking lead tolerance, tooth form and spacing, etc. Among the items of such equipment found here are the Fellows lead checker, Michigan Tool, and Illinois Tool instruments.

Another aspect of quality control is provision for inspecting surface quality, using the now familiar Magnaflex Method equipment of several types.

Stemming from the general character of this plant, and we refer particularly to the absence of what might be termed progressive manufacturing lines, there are no mechanized conveyor lines in evidence at this writing. Materials handling is accomplished entirely by the use of a variety of types of industrial trucks.

With this background of the general features of the plant, we are prepared to note some of the major operations on several of the parts produced here. The examples described below touch on jobs which mark a good sampling of the activity in various departments.

Consider the bull-ring, first. This is easily the largest and most intricate part made here and is produced from a heavy Nitralloy forging. First operations—normalizing in Electric Furnace oven, sand-blasting in a Pangborn machine, and inspection—are done in the heat treating department. Rough turning of the inside and outside surfaces is done on a battery of 4L Gisholt turret lathes; followed by finish-turning of the same surfaces on Gisholts, all using Carboly-tipped tools. Grinding of the bore and grinding of the front face are handled on Heald 72A internal grinders.

External grinding is done on Norton cylindrical grinders. Following these initial operations, the part is routed to the polishing room where it is burred, ground, and polished while rotating on a special jack. It is then slushed in a Varsol mixture, tin-plated, de-magnetized and slushed.

Principal operations of interest in the later stages are those of cutting the external gear, the internal gear, and hub splines on Fellows gear shapers. The external gear is cut first, rough and finishing cuts being taken in separate setting on two Fellows machines. The internal gear is shaped on a Fellows machine, in one setting, but completing the job in three cycles of the work. In this operation, the blank is carefully gaged and aligned so as to have concentricity between the pitch

lines of both internal and external gears within 0.002 in.

The gear then returns to the heat treating department where it is nitrided in one of the E-F nitriding furnaces. The cycle is 50 hours at 975 deg. F. This produces a thickness of case ranging from 0.018 to 0.020 in.

Following nitriding are a number of detail grinding operations, then the internal gear teeth are lapped on a Fellows gear lapper, chucking the work from the OD. The external teeth, too, are lapped on a Fellows, chucking from the bore.

Next operation is the cutting of the spline. In preparation for this, they

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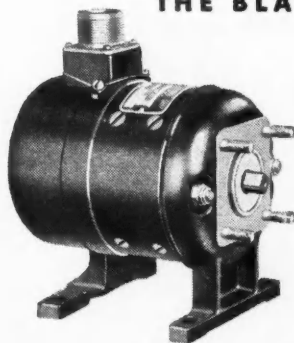


AWARE of the important advantages of low weight and compactness, many design engineers are already specifying Black & Decker special application motors in their "blueprints for tomorrow."

Designing the motor for your particular application frequently permits not only a reduction in motor weight because of higher efficiency, but a decrease in weight of the product itself.

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take a light cut in the bore, then move the work to the Fellows gear shaper. Here again they use a special gaging fixture which locates the spline with respect to the external gear for controlling timing. The spline is cut in one cycle on the shaper. It is finished by grinding on a Geargrind machine, fitted with a small diameter formed wheel with sufficient clearance to enter the bore. A spline tooth then is removed on a Pratt & Whitney vertical shaper to provide a definite location for timing.

After a number of polishing and blending operations, the bull-ring goes to a special marking machine where

the timing marks are etched on the rim, locating from the internal spline tooth. It is then Magnafused, inspected, de-greased in a Detrex washer, lead-plated, washed in Varsol, and inspected ready for shipment to the engine assembly plant.

Altogether the bull-ring requires 67 separate operations from rough forging to finish, 19 of these being inspection steps.

The pinion carrier is an exceedingly intricate piece to fashion what with the problems involved in the finishing of the twenty trunnions which carry the pinions. It requires 83 separate operations, 16 being inspection steps.

The forging is normalized in an E-F furnace, sand-blasted, rough inspected, then turned, counterbored, faced and chamfered on a battery of 4L Gisholt turret lathes. Faces are ground on Blanchard surface grinders, the bore ground on a Bryant internal grinder. Some interesting operations follow on the drill press line-up where the trunnions are rough- and finish-hollow-milled and the spaces between trunnions blended in separate settings on Baker drills of two-spindle and single-spindle type.

Finish-turning of the OD, facing of the web and undercutting are done on another group of Gisholts. Then follow milling of the oil groove in each trunnion and drilling of the oil hole in each trunnion. The work is then copper-plated, and the plate removed from the trunnions on a Heald Bore-Matic. This is followed by carburizing, hardening, degreasing, chemical cleaning in a Bullard-Dunn process machine, stripping of copper plate and drawing.

Next comes cadmium plating of the entire piece, then grinding the ends of trunnions on a Blanchard surface grinder, followed by a number of grinding operations. Trunnion holes are drilled, then reamed on a multiple spindle Natco. Trunnion bores are finished after reaming by broaching on a small vertical American broaching machine using short push broaches. Among the succeeding operations are—grinding the OD of the cage on a Norton cylindrical grinder, and the finish-grinding of each trunnion in a special set-up on a Bryant internal grinder, using a single hollow wheel and indexing each trunnion into position on a counter-balanced fixture. Following grinding, the trunnions are lapped individually on single-spindle Leland-Gifford drills.

The carrier is polished all over, Magnafused and final-inspected.

Several other parts may be examined profitably to indicate the variety of process involved in work of this character. For example, the starter and accessory drive shaft has 102 separate operations, 16 of these being inspection steps. The forging is normalized and annealed, then subjected to a series of turning and grinding operations, then copper-plated. This is followed by grinding, gear cutting, and shaping of the three-jaw driving clutch on a Fellows gear shaper. The operation of shaping is done so beautifully as to make it unnecessary to provide further finishing except for burring.

Following numerous detail operations, the work is degreased and carburized, then stress-annealed, and the copper-plate stripped. It proceeds to some additional drilling and reaming operations, then is hardened, degreased and inspected. The remaining steps in the routing cover grinding, lapping of internal splines, polishing and blending, winding up with Magnafuse and physical inspection.

Another example of backtracking to heat treat and plating is found in the



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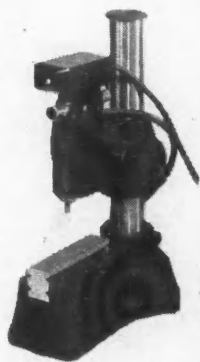
... and costly!

Inexperience, ineptness, fatigue, ill-health, inattention, indifference—all are possible bugaboos when using fixed gages on extremely close tolerance work (i. e., checking to "tenths").

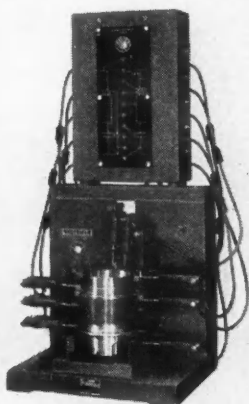
Scrap, wasted time, production slow-downs, faulty products—these are the high costs of rejecting good parts or passing incorrect parts as being good.

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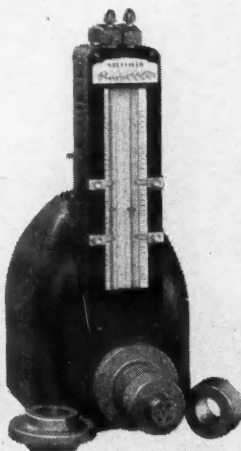
Sheffield precision gaging equipment eliminates "human" error. Write for new Folder No. 43-1 and name of Sheffield Engineering Representative in your vicinity.



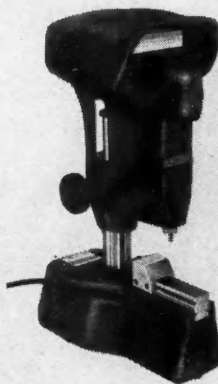
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DAYTON, OHIO, U. S. A.



case of the intake and exhaust cam ring. The forging is normalized and annealed prior to machining. After a series of preliminary turning and grinding stages, the piece is copper-plated, bored, ground, and gear teeth cut on Barber-Colman hobbars. This is followed by carburizing and degreasing, then stress anneal, hardening and degreasing, chemical cleaning in the Bullard-Dunn process machine. Then the copper plate is stripped and the work drawn.

A large battery of Landis hydraulic grinders is employed for the finish-grinding of the cams. The cam ring requires 71 distinct operations, 19 be-

ing inspection stages.

It may be of interest in closing to comment briefly on the relatively great mass of material that must be removed from parts such as have been mentioned above. For example, the intake and exhaust cam comes in as a rough forging weighing about 43 pounds. When this part has completed its course in the machine shop the finished weight is only about 14 pounds or about 32 per cent of original weight.

The reduction gear pinion carrier is received as a rough forging at around 31 pounds and is reduced to but 12 pounds after machining, marking about 60 per cent metal removal.

The reduction driving gear or bull-ring weighs over 76 pounds in the rough, is finished to around 20 pounds after machining. In this instance, chip removal is of the order of almost 75 per cent.

The starter and accessory drive shaft weighs around 18 pounds as a rough forging. It is reduced to but 5 pounds in the machine shop, marking chip removal of the order of about 73 per cent.

The foregoing is an interesting commentary on metal removal problems associated with modern airplane manufacturing practice, emphasizes the role of cemented carbide tools in the mass production of chips.

The word picture of Studebaker's airplane engine gear plant is necessarily sketchy and intended to provide but a glimpse of this outstanding operation. Needless to say, it would require considerably more space and much more detail to adequately cover the multiplicity of techniques employed here. It is hoped that the carefully selected pictorial views will give the reader some impression of the variety of modern production equipment necessary to do the job well.

Development of Light Diesel for the Navy

(Continued from page 25)

The engine as now produced is a 16-cylinder, 4-bank radial, two-cycle Diesel. It is capable of delivering a maximum of 1200 bhp on the test stand. However, the power rating for continuous duty as a main propulsion unit is less than the maximum to conform to the Navy's policy of conservative ratings with attendant increase in reliability and decrease in maintenance. Based on the maximum power, the engine has a weight power ratio of slightly over 4 lb per hp. This is about $\frac{1}{4}$ to $\frac{1}{5}$ the weight of previous marine diesel engines of comparable power output. In the matter of compactness, the engine occupies only about $\frac{1}{3}$ the space of more conventional engines.

Starting at the top of the engine, we might say that it is divided into four main groups—the blower and upper accessories, the power section, the gear box, with a 2-to-1 reduction, and the lower accessory group. The lower accessory group consists of a coolant pump, sea water pump, lube oil pressure pump, piston cooling oil pump, and lube oil scavenging pump.

The upper accessories group consists of a governor, primary fuel supply pump, tachometer drives and throttle controls. Bush rods are arranged in a row along each bank of cylinders. These are operated by a single camshaft located in the Vee between the two cylinder banks. The two forward banks of cylinders are likewise served by a single camshaft. A section



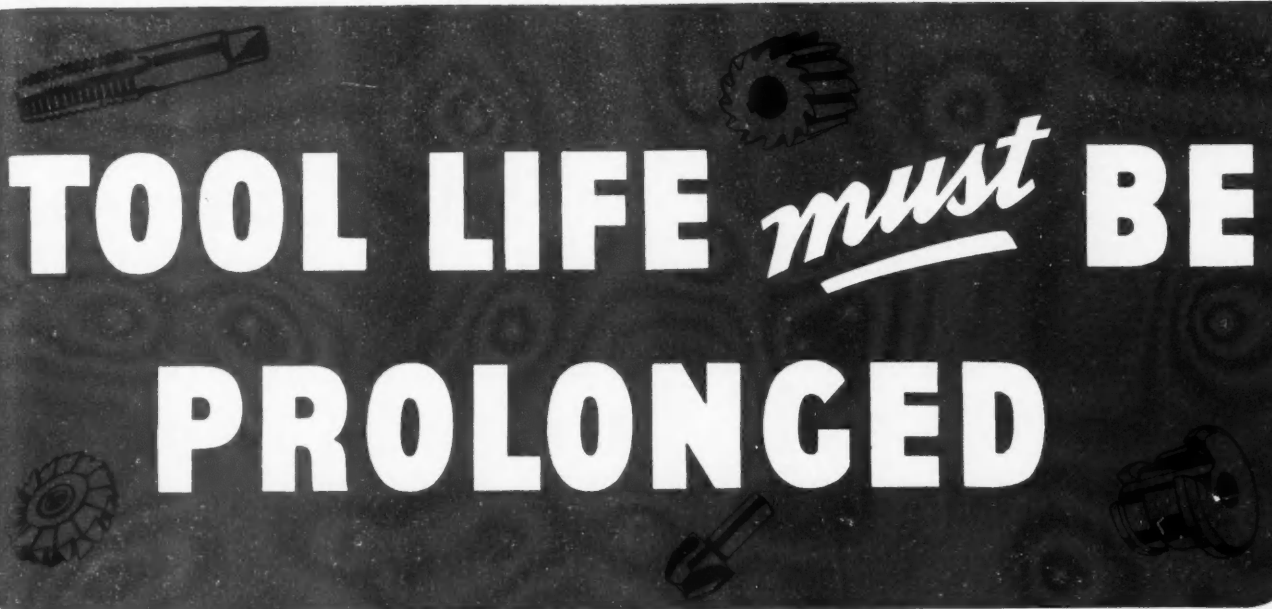
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TOOL LIFE *must* BE PROLONGED

Houghton offers 2 helpful ideas

1

SALT BATH CASING OF TOOLS

Molten salt bath treatment of tools after the regular cycle of heat treatment has resulted in triple tool life—and more!

This nitride case is applied by a few minutes' immersion at 1000–1050° F., and provides hardness up to 1100 Brinell.

Spline broaches, for example, lasted for only 12 pieces in one plant. After nitriding the broaches they produced 300 pieces. Another user of Liquid Heat 720—the Houghton salt for this purpose—reports an increase from 100 shells per tap between grinds, to 2200 shells before grinding was necessary. In many instances, tool life has been increased 300 to 500%. Some plants make it a practice to treat all new broaches before using them.

The cost of this salt bath treatment is extremely low—the results extremely valuable in conserving precious tools. Write for copy of paper presented at A. S. T. E. Convention describing this final casing treatment in detail.

2

CAREFUL SELECTION OF CUTTING FLUIDS

One important way to preserve precious tools is to examine carefully the cutting fluids being used.

Anti-welding properties are provided by sulphur additions of the right type, correctly blended. Extreme pressure properties enable the oils to carry greater loads, withstand higher pressures. Carefully chosen additives permit the use of lighter-colored oils, giving better visibility of the work.

Treatments such as these mean longer tool life, finer finish, and the faster production so vitally needed today.

BUY THE BASE AND SAVE THE SPACE

Houghton Cutting Concentrates enable the user to purchase blending oil locally and save needed shipping space on crowded transportation lines. These bases are highly concentrated, enabling greater dilutions. A selection to handle any machining operation can be readily made if you consult the Houghton Man.

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through the power producing portion of the engine illustrates clearly the radial arrangement of the cylinders. It was from this vertical stacking of four, 4-cylinder radial elements that the engine got its nickname of "Pan-cake."

The crankcase is a completely welded one-piece structure. It is built up in layers of four cylinder radial elements at a time. The main stress members are alloy steel, "X" shaped plates running in a horizontal plane, and spaced apart by hexagonal shaped plates. Due to the one-piece construction of the crankcase, it is necessary to feed the crankshaft assembly into one end of

the case. The main bearings are housed in a forged steel "X" shaped member. These are made in halves, and are assembled onto the main journals before the shaft is lowered into place.

The arrangement of intake ports and exhaust valves is similar to all General Motors two-cycle Diesels. The system employed is sometimes referred to as Uni-Flow, in that the air enters the ports in the cylinder barrel, and blows straight through the cylinder and out through the exhaust valves.

The method of retaining the cylinder in the cylinder block is probably best illustrated by the order of assembly.

The complete cylinder assembly with piston and connecting rod inserted into it, are guided into the crankcase, until the lower flange of the cylinder rests against the crankcase at this point. After the four cylinders have been so inserted into any one bank, a casting four cylinders long called an exhaust housing, is slipped over the cylinder heads and bolted to the crankcase by a row of studs around each cylinder. The explosion load is therefore taken directly from the cylinder at this point and transferred through the exhaust housing and into the crankcase via the exhaust housing studs.

The piston consists of a forged steel head and a skirt made from steel tubing welded together just above the ring belt. There are no wrist pin holes through the piston skirt. There are two forged steel trunnions on either side of the connecting rod, which are bolted directly to the head forging. A silver plated floating bushing is used between the connecting rod and the wrist pin.

Each cylinder consists of two main sub-assemblies—the cylinder head and the cylinder barrel. The cylinder head is composed of a steel forging to which is welded a light sheet metal water jacket. The upper deck of the head is formed by another forging, this one having a flat disk welded on the under side to form the water passage. A steel tube passing through the middle of each of these welded sub-assemblies ties them together. The cylinder barrel and port ring are made from steel tubing. The inlet ports are punched out of both the barrel and the port ring.

The port ring, lower water jacket, and lower cylinder flange are all hydrogen brazed in place. The top of the barrel has an external thread, and the cylinder head forging has an internal thread. At assembly, the upper water jacket is slipped down over the barrel, and the cylinder head is screwed onto the barrel until it seats tightly against a copper plated steel gasket. The water jacket is then welded to the port ring and to the cylinder head. The complete assembly only weighs about 30 pounds, although it is constructed entirely of steel.

The blower used is of the centrifugal type. Its design is quite similar to that currently used on most high output gasoline aircraft engines. It is driven from the top end of the crankshaft through a spring coupling, the drive ratio being approximately 10 to 1, thus giving an impeller speed of 18,000 rpm at rated rpm of the engine. Air passes from the inlet in the center out radially through the impeller blades, through the diffuser, and into the discharge scrolls. Each discharge scroll leads to an air passage in the crankcase which is common to two banks of cylinders. The rated output of the blower is approximately 4000 cfm at 6 psi gage discharge pressure. The complete assembly weighs about 100 pounds.

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WHEN SELECTING FINISHING MATERIALS



★ Today you can't afford to take the least risk or chance in the selection of *any* material that affects the ultimate production of war equipment. If you do, you're gambling with time—and *time is not expendable!*

You can never recover or replace lost production finishing time. Every minute saved in the finishing of your product be it metal, plastic, wood or what-have-you, is a minute added to your increased output. Helping you conserve this precious time—helping you eliminate rejects, step up finishing production, cut operating and material costs, is the dedicated purpose of McALEER, men, methods and materials TODAY!

It is the *plus* you receive when you take advantage of *McALEER Advisory Service*. Brought to bear on your specific finishing problem it is the *plus* of protection you must have in order to *Produce Enough . . . in Time!* We want to work with you. *Let's get on with the job!*

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CARBIDE TOOL

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TO HELP FURTHER INCREASE WAR PRODUCTION

★ CARBIDE TOOL TRAINING COURSE

To help carbide users in war industries speed the training of new men, apprentices, and those being converted to carbide tool use in the metal working trades, Carboloy Company operates an instruction course at its Detroit plant for the training of carbide users' key men. These men receive one week's training in the fundamentals of design, brazing, application and maintenance of carbide tools, through actual shop practice, discussion periods, and training film showings. The men return to their own plants with a basic knowledge of carbide practice—and recommended procedure for training their own men, assisted, when desired, by our field engineers.

During the two years in which this training course has operated, carbide users in 39 states and 3 allied countries have received this training. The course is operated without charge as a service to war industries. A similar service is available to cartridge case die users—to instruct in the finishing and servicing of carbide dies for drawing cartridge cases.



★ FIELD SERVICE

Since the day cemented carbide was first introduced—as a new, strange, "revolutionary" tool material—Carboloy has maintained a large, active staff of experienced field engineers to assist users in all phases of carbide tool practice. As an example of the type of service these men render, in one year alone they trained more than 5,000 men in users' plants in the correct methods of rapid carbide tool grinding.

★ SPECIALLY DEVELOPED GRINDING EQUIPMENT

Special carbide grinding equipment developed by Carboloy Company in co-operation with machine builders, plus special rapid grinding technique, conserves carbides, reduces down time on thousands of vital war jobs. (Cat. GT-141.)

★ NEW CHIP BREAKER GRINDER

New!—Improved type of grinder for grinding chip breakers in carbide steel cutting tools, including roller turner tools. Sturdier, larger table, high and low speed table travel. Also adaptable to grinding precision boring tools and flat form tools. (Left.)



★ TRAINING FILMS

To help in the gigantic task placed upon industry and government, of training new thousands of workers, a set of six carbide training films—as described below—was made available by Carboloy to industry last fall—to provide detailed training in all phases of carbide tool use. (Booklet GT-151.)

- Film—"WHAT IS CEMENTED CARBIDE?"
- Film—"DESIGNING CARBOLOY TOOLS"
- Film—"BRAZING CARBOLOY TOOLS"
- Film—"CHIP BREAKERS"
- Film—"GRINDING CARBOLOY TOOLS"
- Film—"PUTTING CARBOLOY TOOLS TO WORK"



These six films are available at approximate print cost

★ RESEARCH AND DEVELOPMENT

A special committee on research and development functions at Carboloy to constantly improve present methods and develop new methods, new materials for the future. The work of the men on this committee—headed by Dr. Zay Jeffries, metallurgist and Chairman of the Board of Directors of Carboloy Company—has resulted in many outstanding contributions now helping to further speed war production through carbide usage. This committee will continue its efforts to advance the art in the days of peace as well.

★ ENGINEERING ARTICLES IN THE TECHNICAL PRESS

Through frequent articles in technical magazines Carboloy engineers disseminate information on current phases of carbide use important to war industries. Milling with carbides, machining cast armor plate, renewing worn high speed steel tools, are a few of the many subjects covered in the past 12 months.

★ INSTRUCTIONAL LITERATURE

Each year Carboloy publishes comprehensive engineering bulletins covering latest carbide practice. Current booklets include D-113-R—finishing and servicing cartridge case dies—GT-133—carbide tool manual of design, brazing, grinding, application—GT-127—grinding carbide end cutting tools.



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CARBOLOY CEMENTED CARBIDES

TRADEMARK

TOOLS • DIES • DRESSERS • MASONRY DRILLS • WEAR RESISTANT PARTS

Absenteeism Under Control at Vultee

(Continued from page 24)

the Government, with only a few thousand dollars more needed to put it in the postmaster general's top bracket classification. Since it is operated by Consolidated Vultee, however, it receives the designation only of a contract post office.

Aside from the stamp sales last year, the station sold \$2500 worth of defense stamps, \$7000 in Federal motor vehicle use tax stamps, and issued \$174,527.38 worth of money orders. This last mentioned fact indicates another step to-

ward cutting down absenteeism. It is obvious that a lot of trips to outside postal substations by employees sending money orders are made unnecessary by the presence of the post office at the plant. Established to speed mail service at the plant, the station is a convenience to employees, enabling them to post letters and packages, obtain money orders, buy Federal car stamp stickers and send insured and registered packages and letters at lunch hour or enroute into or out of the plant.

A selective service office at the plant, within 48 hours after date of employment, surveys the selective service status of the employee and proper forms are prepared and forwarded to the local boards by registered mail. Through the subsequent handling of selective service problems for employees, they seldom have to take time from their jobs to appear personally at their local boards.

Several times each year deputy registrars are brought to the plant for the convenience of employees in registering for voting. Both state and federal income tax deputy collectors come to Vultee Field each year just before returns are due to provide aid to employees in making out the forms. Medical treatment is available in a completely equipped and staffed hospital on the grounds so that minor ills can be taken care of without having to take time off to see outside physicians. Information on nurseries where employees may leave their children during working hours is available. Gasoline and tire rationing is handled in conjunction with rider-driver service. These and other services provided under the direction of the plant's Industrial Relations Department are helping to combat causes of absenteeism.

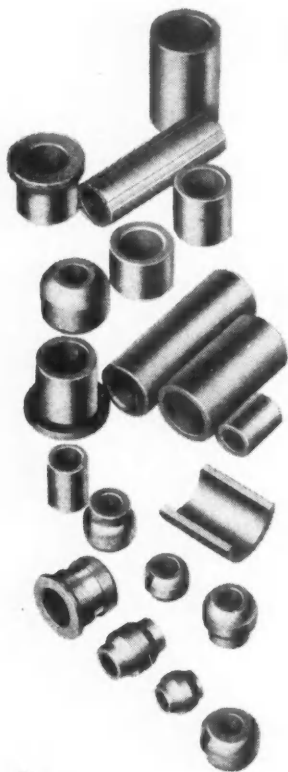
Statistics prepared by the department are submitted to top management so that a study of absentee trends can be made and production schedules arranged to allow for missing workers. During the last six months graphs and charts showed an average absenteeism among male employees of 2.6 per cent and an average among women employees of 3.9 per cent. This makes the plant average for the period 3.3 per cent—considerably below the average reported by other war plants throughout the nation.

Illness of the employee was the largest single cause of absences, with illness or death in the family and transportation difficulties next highest although far behind the leading cause. There were other reasons listed by employees—among them such things as "arm sore from tattoo," "someone let air out of all my tires," "moved house to make room for garden," and "built fence."

These latter isolated causes the Vultee Field Division of Consolidated Vultee Aircraft Corp. probably never will be able to offset, but by and large, the services it provides its employees has been greatly responsible for its excellent absentee record. An employee who is both satisfied with his job and contented at home makes the best sort of workman. It is felt that in offering these services Vultee Field is helping to maintain satisfied workmen who are able and willing to spend more time on the job than those to whom such services are not available.



The BEARING that LUBRICATES itself



Oil is the life blood of every motive unit. In order to gain smooth, quiet operation; long, satisfactory bearing life, we must have the right amount of oil . . . in the right place . . . at the right time.

Johnson LEDALOYL bronze bearings provide this type of performance. Evenly distributed over all surfaces of every LEDALOYL bearing are millions of tiny, evenly spaced pores. Each of these pores serve as miniature oil reservoirs. Heat, generated by the turning of the shaft, draws the oil from the pores into the bearing area. Thus, a thin, protecting film of lubricant separates the shaft from the bearing, reduces friction to a minimum and assures long, satisfactory life. When the shaft stops, the oil is absorbed by the bearing.

Johnson LEDALOYL Bearings will help you simplify your designing problems . . . cut your installation costs. Before you start on a new design, get the facts regarding LEDALOYL. A Johnson Engineer will gladly review your applications at your convenience. Why not call him in . . . TODAY?

Over

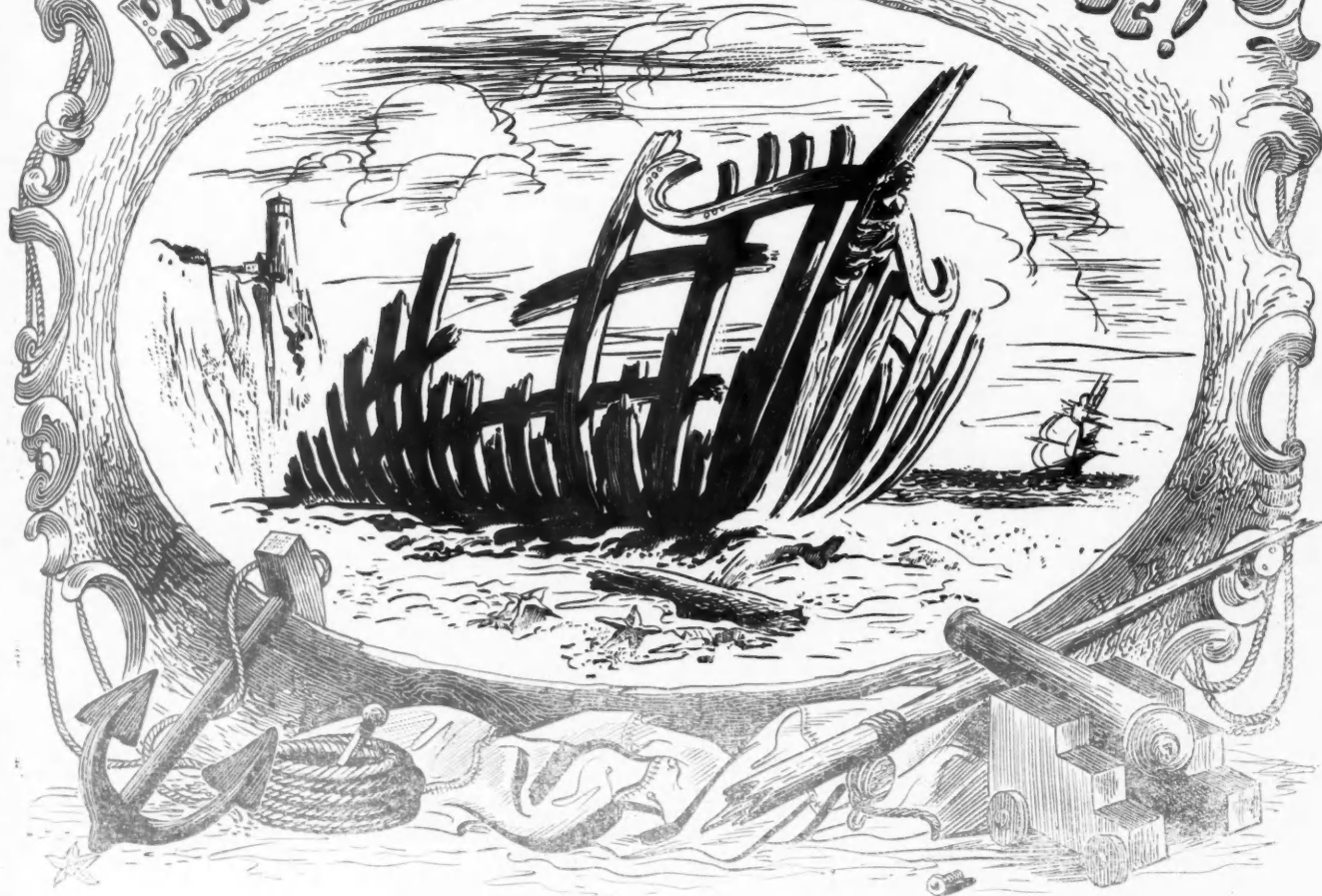
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REMEMBER THE BARNACLE!



With that curtly classic reminder, one of America's most famous research engineers replied to a man in the act of chaffing about the wonderful ingenuity of man.

For the barnacle, he pointed out, is a symbol of all those things that have *not* been done—a tiny marine organism that costs us millions every year—simple, “impossible” things that are still to be accomplished.

The development of lighter and stronger alloys, permitting 3, 5, or even 10 horsepower for every pound of engine weight, instead of one-to-one . . . cheaper color photographs and faster engravings and better television . . . swifter ways of making and working new super-hard alloys . . . scores of different kinds of rubber “growing” on factory floors, and fuels 3 or 4 times as powerful as 100-octane gasoline . . . even solar energy, and atomic power, and—remember the barnacle! These are but a few from a list of certainties and possibilities as long as man's imagination.

Under the secrecy of forced-draught war research, many incredible accomplishments—seemingly impossible within

our time—have already occurred. For obvious reasons, these may not be discussed, but of one thing we can be certain: The end of this war will inaugurate the greatest era of industrial surprises since the age of machinery began.

And the shift to light metals and plastics may be as consequential as the shift from bronze to iron!

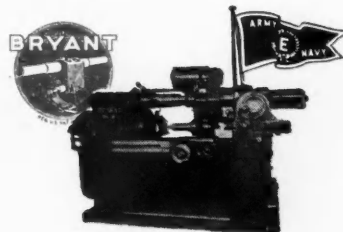
We at Bryant have developed many new techniques during the past few months. Our engineers are working on hundreds of production lines today, helping to solve production problems involving the machining of hard rubber, plastics, glass, graphite, cast iron and bronze, as well as forged, centrifugally cast and surface-hardened steels, light metals and alloys from a hundred new specifications.

If this wealth of new experience can be of value to your business, it's there for the asking. For Bryant's Consulting Service on internal grinding is available to you at all times.

Call upon us now!

Bryant Chucking Grinder Company

SPRINGFIELD, VERMONT, U. S. A.



SEND FOR THE MAN FROM BRYANT

Aircraft Steel Warehousing

(Continued from page 42)

whether or not this equipment might be flown to an advance base.

Warehouses may release these aircraft steels only to the manufacturers of the approved parts to modification centers, and Army and Navy supply depots or for the maintenance or repair of aircraft and airborne equipment.

An added feature of the program makes it possible for the warehouse to assist the manufacturers in the redistribution of surplus stocks. The ware-

house will be notified by the Aircraft Scheduling Unit when such surplus stocks are available and they have been instructed to purchase them from the manufacturer whenever possible.

A detailed copy of the program, the Earmarked Aircraft Stock Directive No. 6 and a complete list of steels to be stocked by the warehouse may be secured from the Procurement District Offices or the Aircraft Scheduling Unit, Dayton, Ohio. Following is a list of

the names and addresses of official aircraft steel warehouses:

1. Aircraft Steel & Supply Co., Wichita, Kan.
2. Baker Steel & Tube Co., Los Angeles, Cal.
3. Columbia Steel Co., Seattle, Wash.
4. Crucible Steel Co., Los Angeles, Cal.
5. Ducommun Metals & Supply Co., Los Angeles, Cal.
6. Edgcomb Steel Co., Hillside, N. J.
7. Peter A. Frasse & Co., New York, N. Y.
8. Peter A. Frasse & Co., Philadelphia, Pa.
9. Garrett Supply Co., Los Angeles, Cal.
10. Hamilton Steel Co., Cleveland, Ohio.
11. Earle M. Jorgensen, Houston, Tex.
12. Earle M. Jorgensen, Los Angeles, Cal.
13. Metal Goods Corp., Houston, Tex.
14. Metal Goods Corp., St. Louis, Mo.
15. Miller Steel Co., Newark, N. J.
16. Joseph T. Ryerson & Son, Inc., Chicago, Ill.
17. Joseph T. Ryerson & Son, Inc., Cincinnati, Ohio.
18. Joseph T. Ryerson & Son, Inc., St. Louis, Mo.
19. Joseph T. Ryerson & Son, Inc., Jersey City, N. J.
20. S.A.E. Steel Co., Cleveland, Ohio.
21. Service Steel Co., Detroit, Mich.
22. U. S. Steel Supply Co., Chicago, Ill.
23. Wheelock-Lovejoy Co., Buffalo, N. Y.
24. Wheelock-Lovejoy Co., Detroit, Mich.
25. Chicago Steel Service Co., Chicago, Ill.
26. Aircraft Steel & Supply Co., Dallas, Tex.

AIR FILTRATION AAF DUST CONTROL



THE SYMBOL of *Clean AIR*

American Air Filter dust control and air filtration equipment is in general use in every field of American Manufacture—reducing operating costs, eliminating dust hazards, accelerating production and protecting quality. Many of the phenomenal achievements of precision manufacturing and the development of most of the new synthetic products have been made possible by American Air Filter dust control.

If you have a dust problem there's an A.A.F. engineer close by who will be glad to discuss it with you without obligation. Send for our latest bulletin "A.A.F. in Industry."

AMERICAN
AAF
AIR FILTERS

AMERICAN AIR FILTER CO., INC.
449 CENTRAL AVENUE, LOUISVILLE, KY.
In Canada—Darling Bros. Ltd., Montreal P. Q.



Steel Production Time Table

Irrespective of the plan under which steel is ordered, it still takes 11 weeks of actual production time to produce heat treated cold drawn bar, for example, and the manufacturers must consider production time cycles in scheduling his own production program.

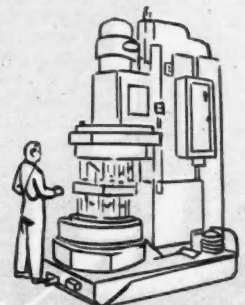
The following time table was condensed from a chart prepared by the Materiel Command, Materiels Branch, under the direction of Lt. Col. A. E. R. Peterka, and presupposes the absolute minimum time under the best possible conditions. It does not include delays caused by backlog of orders, minimum melt requirements, carload lot shipment, credit details or any other restrictions, or rejections.

Minimum time between placing of order and shipment of steel: billets, 15½ weeks; hot rolled bar, 18½ weeks; heat treated cold drawn bar, 22½ weeks; sheet and strip, 19½ weeks.

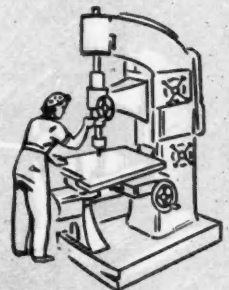
Patent Rights for Skycraft Plane Sold

Grand Rapids Industries, Inc., a combination of 15 Grand Rapids furniture companies, has purchased the manufacturing license and patent rights for the Skycraft light airplane from the General Aircraft Corp., Astoria, L. I. Kent County has given a 15-year lease on a site at the Grand Rapids airport to the furniture group for construction of an assembly plant. It is planned to produce the plane for military use, then convert it for civilian production after the war, according to Frederick H. Mueller, president. The Skyfarer is a two-control rudderless high wing monoplane carrying two persons and powered by a 75-hp. Lycoming engine. Wing span is 31 feet, 5 inches and gross weight is 1,350 pounds.

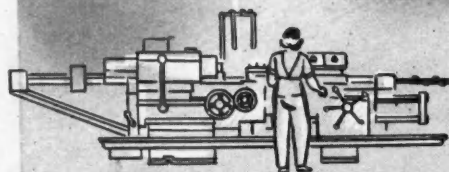
Floating Holders



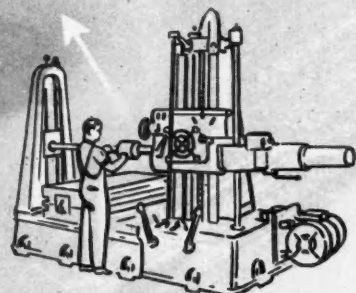
MULTIPLE TAPPING



DRILL PRESSES



TURRET LATHES OR SCREW MACHINES



BORING MILLS

THE Scully-Jones Ball Bearing type Floating Holders drive and float on Ball Bearings for a smooth rolling action... compensating for misalignment between machine spindle and work.

Eliminate scrap from Bell-Mouthed or oversize holes when reaming or precision tapping on AUTOMATIC SCREW MACHINES, LATHES, TURRET LATHES, DRILL PRESSES or MULTIMATIC MACHINES.

Optional Straight, Threaded or Tapered Shanks... Collets with Straight or Tapered Holes.

Scully-JONES

AND COMPANY

1901 SOUTH ROCKWELL STREET * CHICAGO, U. S. A.

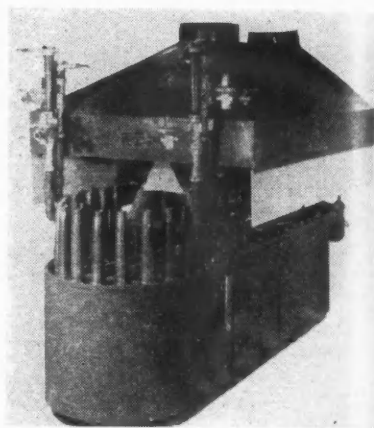
New Production Equipment

(Continued from page 44)

side is driven by a variable speed drive through a totally enclosed worm gear reducer. This chain carries double row ball bearing mounted spindles every pitch. These spindles, in the form of a V-belt pulley, are rotated by a V-belt backed up by adjustable ball-bearing wheels, or, in certain sizes and models, the spindles are sprocket equipped and driven by an adjustable steel roller chain. The spindle rotating mechanism is driven by a separate motor, which is provided with its own

variable speed unit and a totally enclosed worm gear speed reducer. On top of the rotating spindles are bolted work holder adaptors, which are interchangeable for different size cases.

The burner equipment is of the blast line type with zero governors and proportional mixers provided for each burner. The burners are adjusted and arranged to provide a holding or soaking zone, in addition to the heating zone. Burner equipment may be supplied with height adjustments when

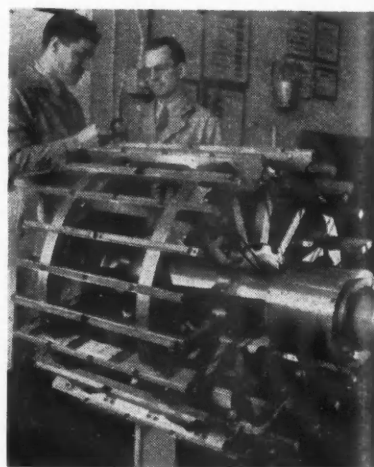


Morrison No. 5710 Annealing Machine

cases of different sizes are to be annealed in one machine. Loading and unloading is a continuous manual operation at one end of the machine.

A LINE of horizontal parallel shaft type-Gearmotors which meet speed reduction requirements for a variety of industrial applications over a range of 1 to 75 hp is now in production at Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. Each new unit conforms to A.G.M.A. standard output speeds and application practices.

The use of adaptor castings between motor and mechanical parts allows the



The largest hone abrading tool which has ever been made was recently shipped by Micromatic Hone Corporation, Detroit, Mich., to a war contractor. This hydraulically controlled hone is 41½" in diameter by approximately 63 ft. long overall, and weighs approximately 6500 lbs. It is intended for use in a bore 40 ft. long and it is anticipated that approximately 1/16" of stock on diameter must be removed to clean up the bore. This will amount to approximately 1990 cubic inches of metal removal, or more than 550 lbs. of metal to be removed by the hone abrading process. The tool is used in a special horizontal honing machine.

BUELL AIR COMPRESSOR

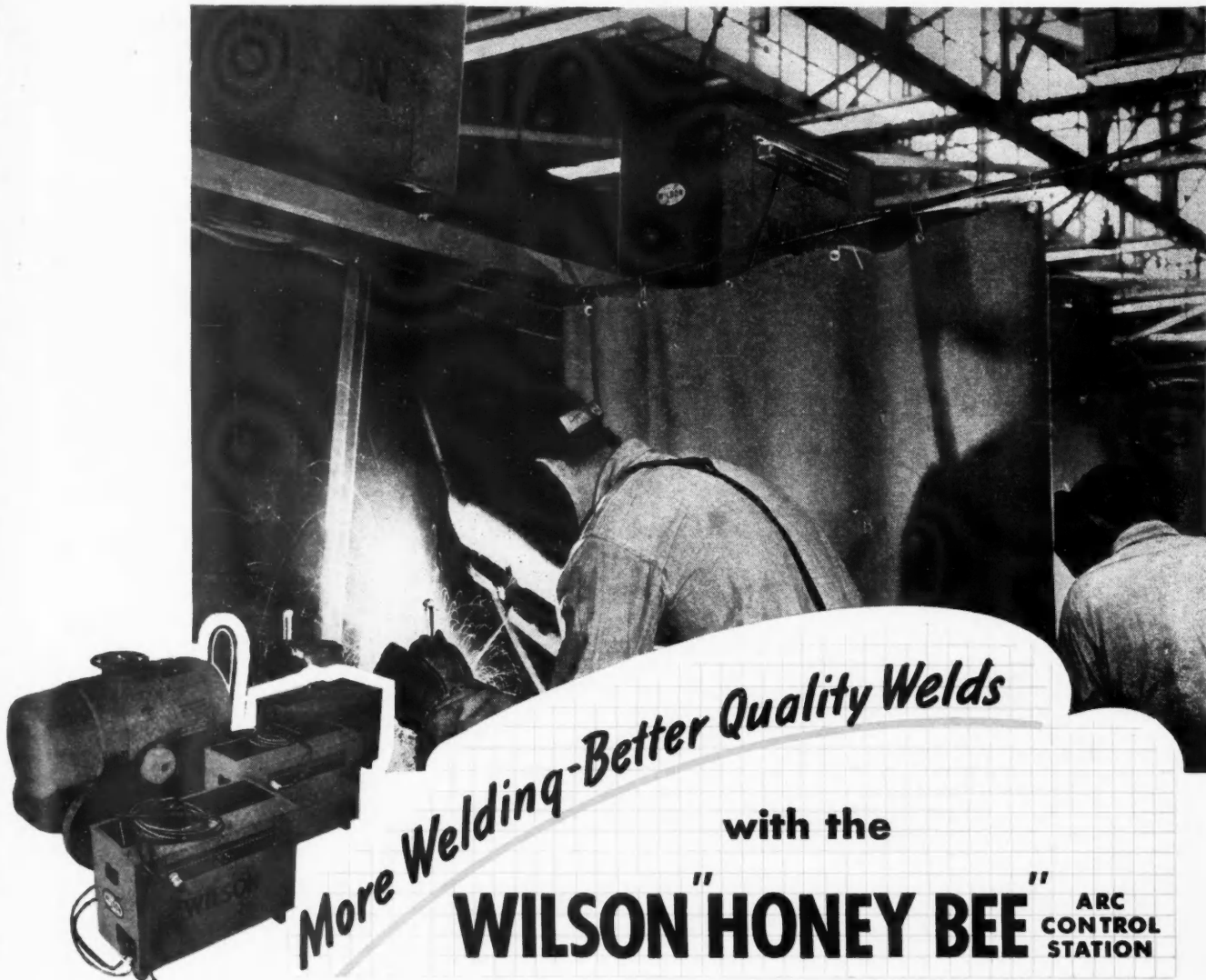
BUELL Air Compressors are used on bomber and fighter planes to operate brakes and machine guns. Here, where reliability is of first importance, their fine workmanship and precision manufacture pay real dividends in dependable operation. 12 years of operation on cars, trucks, buses, boats and railway trains was the proving ground for their adoption as an aviation accessory.

BUELL Air Compressors can be operated at speeds of 2000 to 3400 R.P.M. Pressures in excess of 225 pounds are built. Safety control of air pressure is automatically handled by Buell design and retention of air is assured thru precision valve construction. Self contained oiling, bronze connecting rod and bearings. Moving parts are held to a tolerance of .0002".



BUELL MANUFACTURING CO.

Dept. AA, 2975 COTTAGE GROVE AVE., CHICAGO, ILL.



More Welding—Better Quality Welds

with the

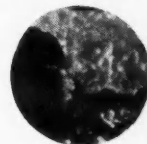
WILSON "HONEY BEE" ARC CONTROL STATION

TWO or more "Honey Bees," connected to any constant potential arc welding generator, increases the number of welding arcs that can operate simultaneously from a single welding machine.

At the same time the "Honey Bee" assures better welds on light gauge metal—thanks to Wilson Remote Crater Control. Craters, porosity and similar defective welds are prevented because Crater Control permits the operator to fade out the arc slowly—never breaking it abruptly.

Each operator using a "Honey Bee" station has full control over his welding current. A switch conveniently held in the operator's hand enables him to regulate his current while welding to any value (from zero to maximum) within the full range of the "Honey Bee" station. Changes in current setting do not affect the performance of any other "Honey Bee" stations working from the same generator.

The Wilson "Honey Bee" is available in two sizes—75 amps. and 150 amps. For complete details get in touch with your nearest Air Reduction sales office. A descriptive bulletin ADW-47 will be forwarded on request.



Metal deposited with standard welding machine and no crater control.



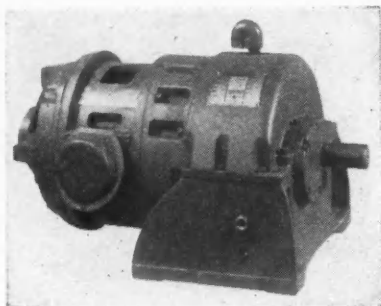
Metal deposited with Wilson "Hornet" equipped with "Honey Bee" Remote Arc and Crater Control Station.



Photo courtesy of Curtiss-Wright Corporation.

WILSON WELDER and METALS CO., INC.

General Offices: 60 East 42nd Street, New York, N. Y.



Westinghouse Gearmotor

use of all standard Westinghouse N.E.M.A. frame motors with each type

of unit, and types of motor construction can therefore be readily changed to suit varying service conditions if necessary in the field. The design of the motor-adaptor assembly being common between unit types, such assembly can be readily shifted between unit types to meet changes in speed requirements. Many working parts, including gear sets, being common to all three unit types of a given rating, replacement part programs are held to a minimum.

Gears and pinions in the new Gearmotors are .40-.50 carbon steel, and are given special heat-treatment before hobbing. This process produces a tapering hardness from surface to core,

and results in tough, impact-resisting teeth. Gears and bearings are lubricated by a positive splash system, and new case design allows oil to circulate freely at all times.

A NEW Swiss-type automatic has recently been introduced by The Wickman Corporation, Detroit, Mich. This machine, the No. 1, handles bar stock up to 5/32 in. diameter, and has a maximum turning length of 1 9/16 in. Its spindle speeds range from 1500 rpm to 12,000 rpm, and its cycles from 2 sec. to 5 min.

The principle employed in this machine is that of feeding the stock through a guide bushing past radially fed tools. Both the headstock carrying the bar stock, and the tools performing the cutting operations, are controlled

PHOTO BY U.S. ARMY SIGNAL CORPS.



STERLING PISTONS STAND THE PUNISHMENT OF COMBAT

Tanks, planes, trucks, reconnaissance cars, marine engines, and other mobile combat units must stand any kind of punishment, any time and place they are called to battle. Whether it's in a blazing desert sandstorm or the frigid temperatures of the Arctic, a motor in battle *must* not fail.

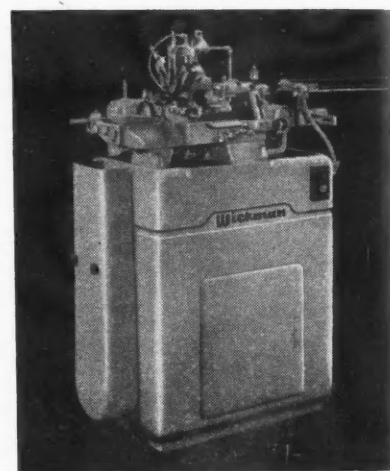
That's tough service for motors and pistons—but thousands of these motors are equipped with Sterling Pistons.

STERLING ALUMINUM PRODUCTS
Incorporated St. Louis, Mo.



STERLING

PISTONS



The Wickman No. 1 Swiss-Type Automatic

by cams. Individual tool slides are of hardened steel construction and are provided with micrometer adjustments, both radially and parallel to the axis of the work. A quick tool clamping device on each tool slide facilitates tool change.

Attachments are available for performing drilling, chamfering, counter-boring, tapping, threading, and slotting operations.

A LINE of electronic heaters for high-frequency induction heating of metal parts for brazing, soldering, and selective heat treating has been developed by the General Electric Company, Schenectady, N. Y. Essentially power oscillators which convert 60-cycle power to high-frequency power at approximately 500,000 cycles, the electronic heaters are available in two standard sizes, one having an output of 5 kw and the other an output of 15 kw.

Simple circuits are employed and the necessary electronic tubes, controls, and other equipment are arranged in compact, completely enclosed cabinets. The use of conservatively rated elements is said to reduce maintenance to the periodical replacement of tubes, which

HANSEN

**A
NAME
THAT MEANS THE
Finest and Most Modern
IN AIRLINE EQUIPMENT**

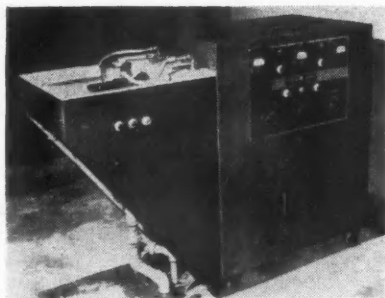
Back of Hansen Air Line Equipment is over a quarter of a century's experience in producing the finest air line equipment on the market. Hand in hand with quality materials is precision work. Hand in hand with quality actual operation. Truly a quality product for those who want the best and in the long run, by far the cheapest. Hansen equipment can be found in large and small industrial plants throughout the world and in actual aviation plants. In Hansen equipment you get modern engineering to meet the demands of the hour—Speed, Production, Ease of Operation, Efficiency and Economy.

Send in today for new free catalog on Hansen Industrial Air Line Equipment.
Hansen—Makers of Push-Tite Air Hose Couplings, Hose Clamps, Hose Clamp Sockets, Hose Clamp Plugs, Air Blow Guns, Engine Cleaners, Sand Blast Cleaners, Air-Liquid Spray Guns.

**USED IN 99% OF ALL
AVIATION PLANTS**

Hansen MANUFACTURING CO.

1786 EAST 27th STREET • CLEVELAND, OHIO



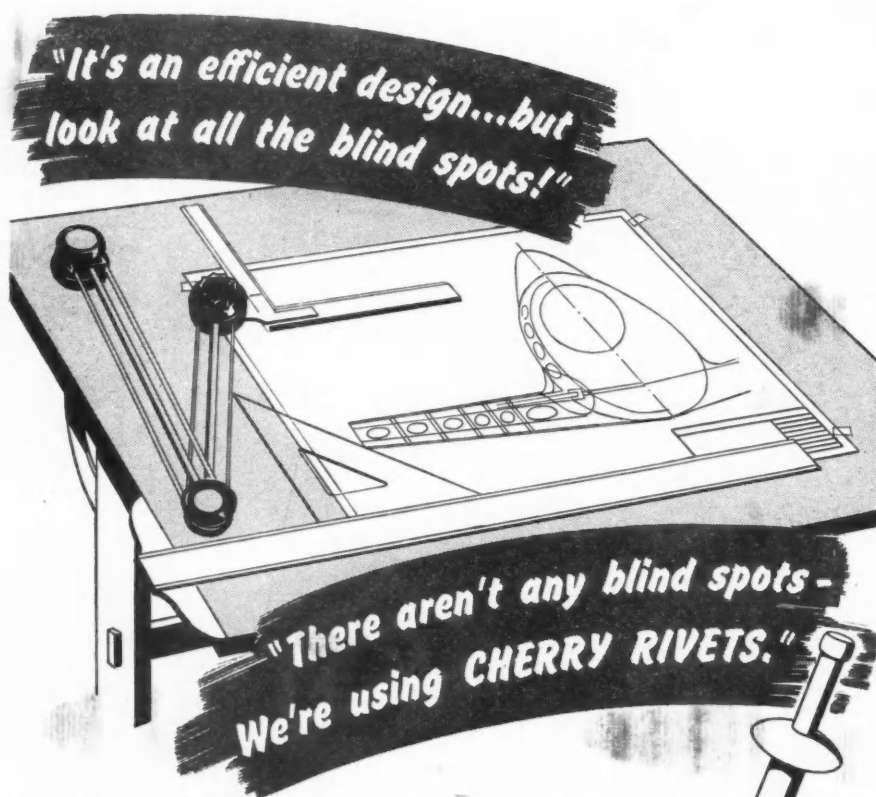
5-Kilowatt General Electric
Electronic Heater

when properly applied have an average life expectancy of 5000 to 10,000 hours and more.

Attached to the electronic heater is a suitable work table with the necessary water-cooled coil or coils connected to the heater terminals. The coils can be fabricated easily in different shapes, depending on the work to be done.

THE Harnischfeger Corporation, Milwaukee, Wis., has added a complete line of Industrial A.C. arc welders to its present line of P&H D.C. machines. Engineered and built for in-

dustrial service, these machines are being made in 7 Heavy Duty and 4 Intermittent Duty models with a range of capacities for handling production welding under continuous operation. The new line features the recently adopted "WSR" (Welding Service Range) ratings which show the actual minimum to maximum output of usable welding current. Specific "WSR" ratings of Heavy Duty models are: 50 to 270 amps., 60 to 375, 90 to 500, 100 to 625, 125 to 750, 150 to 900, and 200 to 1200—of Intermittent Duty Models: 20 to 185 amps., 20 to 235, 20 to 285, and 20 to 335. Setting and control of current throughout complete welding service range involves one adjustment. Improvements in the P&H control make it creep-proof. According to P&H engineers, the A.C. models are marked



The old compromise with efficiency to avoid blind or inaccessible spots in airframe structures has been eliminated by the Cherry Blind Rivet.

This mechanical blind rivet has proved itself in thousands of aircraft and due to its high shear and fatigue values is opening new doors for the engineer. He can now design up to efficiency rather than down to a manufacturing limitation by specifying Cherry Blind Rivets.

The complete story on Cherry Rivets is available. Request your copy of the new Handbook A-43 from Department 5, Cherry Rivet Company, Los Angeles, California.

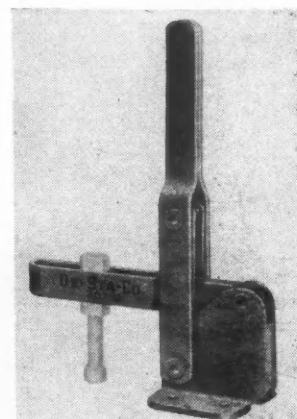
CHERRY RIVETS. THEIR MANUFACTURE AND APPLICATION ARE COVERED BY U. S. PATENTS ISSUED AND PENDING.



P. & H. Industrial A.C.

by a number of other mechanical and electrical refinements which, by actual field tests, have shown an increase in operating efficiency.

A SMALL, light duty clamp, which has recently been added to the De-Sta-Co line of toggle clamps, made by the Detroit Stamping Co., Detroit, Mich., is especially suitable for use in



New De-Sta-Co Toggle

Air Power Through Piston Rings

McQUAY-NORRIS ALTIMIZED PISTON RINGS

**PISTONS... PINS...
HARDENED AND GROUND PARTS**



Wherever planes are flying, McQuay-Norris precision parts of un-failing strength help them perform more efficiently and with greater durability. More and more, the aviation industry is availing itself of our 33 years' experience in making precision parts, our metallurgical research, our engineering and technical facilities. We are now direct contractors to the Army and Navy and sub-contractors on precision parts for aircraft, tanks, scout cars and trucks. Your inquiries are invited.

PARTS FOR AIRCRAFT ENGINES

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Oil Sealing Rings
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Counterweight Cheek Pins
Machined Magnesium Parts
Cylinder Hold Down Nuts
Hardened and Ground Parts**

PARTS FOR PROPELLER ASSEMBLY

**Machined Magnesium Parts
Piston Rings**

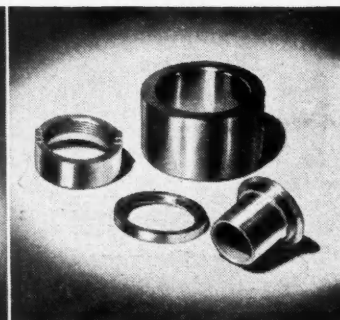
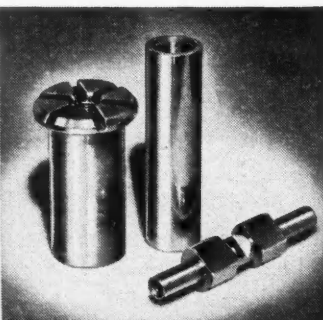
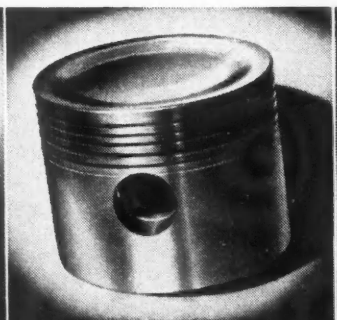
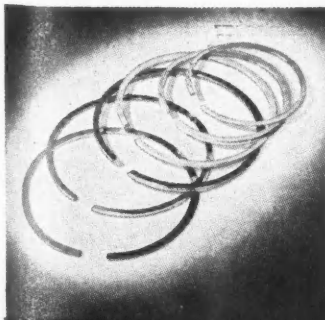
EQUIPMENT FOR MAINTENANCE OF AIRCRAFT

**Pistons for Oxygen
Compressor
Piston Rings for Oxygen
Compressor
Pins for Oxygen Compressor
Pistons for Air Compressor
Pins for Air Compressor
Piston Rings for Air
Compressor**

LANDING GEAR PARTS

**Machined Aluminum Pistons
Piston Rings
Hardened and Ground Parts**

PRECISION WORKERS IN IRON, STEEL, ALUMINUM, BRONZE, MAGNESIUM



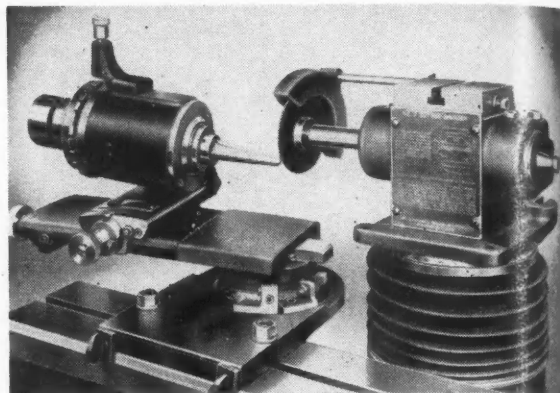
McQUAY-NORRIS MFG. CO. (AIRCRAFT DIVISION), ST. LOUIS, U.S.A.
CANADIAN PLANT, TORONTO, ONTARIO

aircraft construction, or on other work where clamping space is limited.

This new De-Sta-Co clamp measures only 5½ in. in height overall. It has a base 1¾ in. by 1¾ in. Length of bar from handle to tip is 2¼ in.

It is made in two styles: Model 207S with solid straight bar, and Model 207U with "U" shape bar.

Cincinnati No. 1 Radius Grinding Attachment.



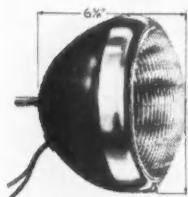
A RADIUS grinding attachment, recently announced by The Cincinnati Milling Machine Co., Cincinnati, Ohio, is designed especially for use on their No. 2 Cutter and Tool Grinder. It has been given the designation "No.

PROPER PROTECTION



with
ARROW

Our armed forces come first. We're the men behind the men behind the guns. It is up to us to keep 'em rolling by devoting most of our time to Army and Navy requirements. *But*—the movement of vital war material and essential civilian supplies must be maintained. Trucks and buses are just as essential as jeeps and tanks. The demand for lighting equipment is terrific—that is why ARROW is spelled out on a brand new modern plant in Mt. Holly, New Jersey. In making this addition, we hope to take care of all demands for Arrow lighting equipment. Ask your jobber or address Dept. 195.



SEALED BEAM HEAD LAMPS



PLASTIC REFLECTORS



OIL & ELECTRIC FLARES



MARKER LAMP AND TURN SIGNALS

ARROW SAFETY DEVICE CO.

GENERAL OFFICES: MT. HOLLY, N. J. • PLANTS IN MT. HOLLY and MEDFORD, N. J.

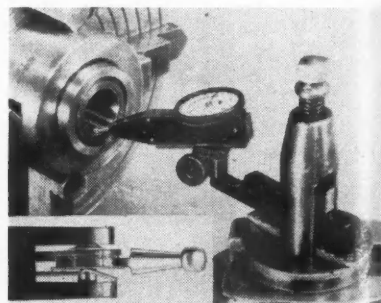
1 Size," to differentiate it from a similar attachment for face mills.

A wide range of cutters may be ground on this unit. As the name indicates, it facilitates the grinding of ball-end cutters and die sinking cutters. With the addition of accessory equipment, other types of work may be handled, such as double-end cutters and cylindrical grinding of die-sinking tracer fingers.

The attachment has two slides, each having longitudinal and transverse adjustment of the work with respect to the grinding wheel. A large diameter anti-friction pivot in the base is arranged so that the slides may be swiveled as a unit through 360 deg. Incorporated in the base are movable stops having screw adjustment which limit the swivel motion to the desired amount.

The index plate at the rear of the work-head spindle has 24 notches. With this device, the attachment will handle straight flutes cutters having 1, 2, 3, 4, 6, 8, 12 and 24 flutes, without the necessity of a tooth rest. When grinding cutters with helical flutes, the universal tooth rest supplied with the machine may be used. The attachment handles ball-nose cutters up to 3 in. diameter. The work spindle taper is No. 5 Morse. Accessory equipment includes a motor, for grinding cylindrical parts such as tracer fingers; collets and sleeves for grinding straight shank cutters ranging from ⅛" to 1¼" shank diameter; and collets for grinding taper shank cutters ranging from No. 4 to 11 B&S shanks.

THE Testmaster Indicator, a recent development of the Federal Products Corporation, Providence, R. I.,



Federal Testmaster Indicator



**ABLE TO TAKE IT--
ON THE BATTLE LINE**

ABLE TO TAKE IT--

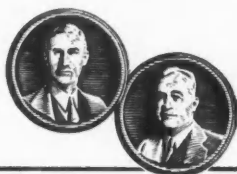
**IN THE TOOL ROOM OR ON
THE PRODUCTION LINE**

Built to "dish it out" and take it, too, Uncle Sam's tanks demand tough materials and skilled design to give them stamina and striking power.

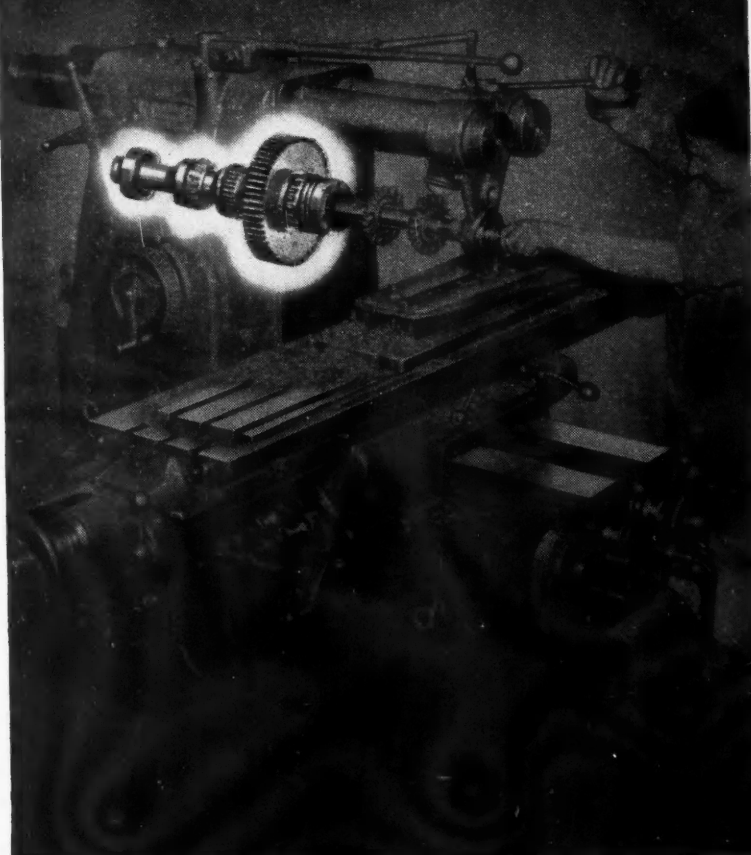
The same principles hold for milling machines—the machine tools that are mighty important in building tanks and other weapons. In tool room or on the production line, milling machines must be built to perform at a record-breaking pace and maintain close tolerance-accuracy in operation.

The center bearing on the spindle of Milwaukee Milling Machines reduces by one-half the distance between bearings—*increases rigidity eight times!*

Ask the man at the controls of a Milwaukee—he can tell you how important this center bearing is (in addition to the husky column) in providing built-in rigidity and all that it means in sustained accuracy — longer cutter life — smoother performance at all speeds and feeds.



KEARNEY & TRECKER
CORPORATION
MILWAUKEE, WISCONSIN



Buy Victory with at least 10% in War Bonds!

Milwaukee **MACHINE TOOLS**

June 15, 1943

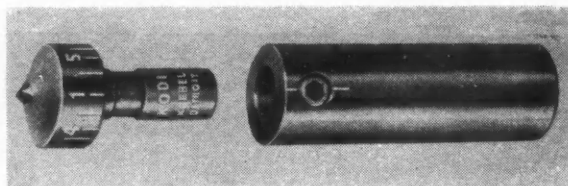
When writing to advertisers please mention **AUTOMOTIVE and AVIATION INDUSTRIES**

features a new ratchet index point which locks in place. This hard chrome plated index point can be set at any angle within 180 deg. arc, and may be removed for replacement, if desired. A lever at the side of the instrument reverses the direction of operation of the point. Dovetail slides and a universal clamp facilitate easy setting and insure rigid support.

THE Koebel Diamond Tool Company, Detroit, Mich., has designed a diamond dressing tool which does away with the necessity of a special dresser for each machine. The new tool, which

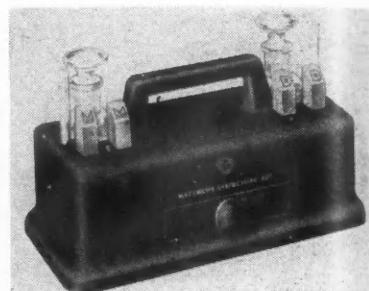
The "Kodi" Diamond Dressing Tool

is known by the trade name of "Kodi," is supplied initially with a special shank, or Ko-Adaptor, fitted with a recessed head set-screw to lock the standard Kodi nib in position. Once installed, the Ko-Adaptor remains on the machine, only the Kodi nib is removed for re-setting or replacement. Since one



Kodi nib fits all Ko-Adaptors, the replacement supply need never be very large.

AN INSPECTOR'S KIT, made of acid proof, non-critical material, has just gone into production at Jas. H. Matthews & Co., Pittsburgh, Pa. The kit holds four Matthews "S-22" Synthetic Stamps, a stamp pad, and two bottles, one for acid etching ink and



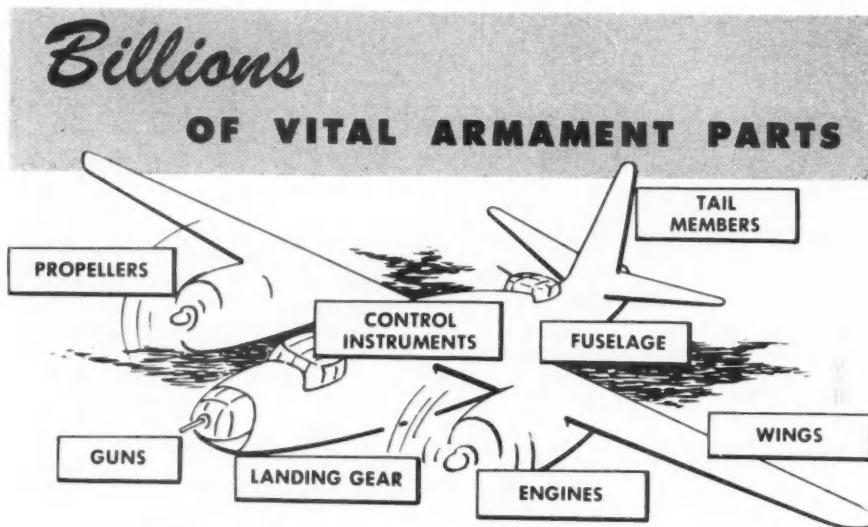
Matthews Inspector's Kit

the other for oil or neutralizer. The stamp pad is kept in a drawer at the front of the unit, and may be easily pulled out for re-inking. A self-closing cover over the stamp pad prevents the escape of acid fumes. Kits are available to hold more than four stamps if desired.

THE Cleco Riv-N-Jector has been placed on the market by The Cleveland Pneumatic Tool Company, Cleveland, Ohio. The device is light in weight, and holds up to 50 rivets. In operation, the injector is gripped like a pencil and its jaws are placed on the work so as to straddle the hole into which the rivet is to be inserted. A slight pressure on the tool forces the rivet into the hole and allows the next rivet to move into a position ready for insertion.



The Cleco Riv-N-Jector



are Cleaned with DETREX EQUIPMENT AND CHEMICALS

Aircraft manufacture represents but one of the many phases of armament production in which Detrex products are in constant use. Throughout all metal industries where war material of every type is being produced, Detrex machines and chemicals are meeting every requirement for effective and economical metal cleaning.

Among the many applications for which equipment and chemicals have recently been specifically designed and developed are cleaning aluminum prior to anodizing, alrock, chromic acid dipping, and spot welding—as well as electrolytic cleaning prior to plating.

To meet the metal cleaning needs of every manufacturer, Detrex manufactures: Degreasers using stabilized safety solvents, Perm-A-Clor and Triad . . . Washers for Alkali, Spirits and Emulsion Cleaning . . . Rust Proofing and Processing Machines . . . and Triad Cleaning Compounds, Strippers, Emulsion, Wet Spray Booth Materials.



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DETROIT REX PRODUCTS COMPANY

13001 HILLVIEW AVENUE • DETROIT, MICHIGAN

Branch Offices in Principal Cities of U. S. A. — In Canada: Canadian Hanson & Van Winkle Co., Ltd., Toronto, Ontario

The deHavilland Mosquito

(Continued from page 31)

bottom of the spars and is of double thickness on top, with spanwise spruce stringers sandwiched between diagonal layers of ply. A false leading edge is attached to the front spar. The whole of the wing is screwed, glued and pinned, and then covered with fabric and doped.

The ailerons are exceptional in being constructed of light alloy; they are 12 ft 6 in. long and extend almost from the tip to the slotted flap, which runs inboard to the nacelle and then from nacelle to fuselage.

The two Rolls Royce Merlin 21 engines are mounted on the leading edge of the wing on welded steel tube bearers, and are slung low so that the top of the cowlings is level with the leading edge of the wings. A 15% Imp. gal oil tank is located in each undercarriage well, behind the fireproof bulkhead. The radiator installation in the leading edge of the wing on each side of the fuselage has its air exit controlled by a flap under the wing surface forward of the front spar, for the leading edge is set forward by 22 in. to accommodate the radiators without cutting into the spar. Each radiator unit consists of three parts; the outboard section is the oil cooler, next is the coolant radiator and next again, inboard, the cabin heater. Effective cabin heating is thus secured with little extra weight.

For normal ranges of operation all fuel is carried in eight wing tanks, four on each side, with a total capacity of about 400 Imp. gal. Extra tanks of 150 Imp. gal capacity can be fitted in the fuselage for long range work.

With regard to the armament of the fighter version of the Mosquito, the mounting of the four machine guns in the nose and the four cannon below the latter not only gives exceptional concentration of fire but also provides unusual accessibility for overhaul and servicing. The guns are all fired electro-pneumatically. For this purpose there is in the port engine nacelle a compressor that also serves for the pneumatic wheel brakes. There are two vacuum pumps, one on each engine, which together operate the instrument flying panel; if either of these pumps should fail it is automatically isolated and the other is able to carry on.

The cockpit gives comfortable accommodation, side-by-side, for pilot and observer and is entered through a hatch in the floor of the bomber, whereas the fighter has an entry door in the side of the nose owing to the floor being taken up with the barrels of the four cannon. A telescopic ladder gives access to the cabin. The bomber has a V-shaped windscreen with two layers of glass, between which is passed a constant current of warm air to prevent misting and icing. The fighter has a flat bullet-proof screen.

In the bomber, the transparent nose accommodates the observer-bombardier when he goes forward to drop his bombs. An optically flat panel gives an excellent view and is kept clear of ice by the same means as that used for the cockpit screen. The bomb bay is in the center section of the fuselage under the wing. Behind this is accommodation for various items of equipment, including a 2 1/4 Imp. gal hydraulic tank and oxygen bottles permanently installed.

From the flying point of view the chief difference between bomber and fighter is that while the bomber has normal spectacle control on top of the laterally fixed stick, the fighter has a jointed stick control column. The reason given for this is that a wheel (spectacle) control is more restful for "stooping" on a long flight, whereas a stick is more convenient for firing the guns by button control.

The tail unit is notable in two respects, viz., the non-shimmying retracting wheel and the automatic rudder bias. The bugbear of tail wheel shimmy is overcome by a Dunlop tire with a very wide tread having a deep circumferential groove, which gives a definite two-point contact with the ground. Only a small air space is built into the tire, which is normally inflated to 40 lb pressure.



SEE "AEROSCREW" FOR...



STEEL DRILLED HEAD AIRCRAFT BOLTS

Generally known as "Engine Bolts" and widely used in aircraft construction where bolts with heads drilled to accommodate lock wire are required. Holes drilled through all faces to meet center hole in top of hexagon head. Made of heat-treated nickel steel to conform with Army-Navy specifications, in types AN73 through AN81 and sizes up to 6" length. Also in coarse thread (NC3) or fine thread (NF3) styles. Carefully inspected and tested for quality, accuracy, and uniformity. Cadmium plating conforms to AN-QQ-P-421. Identified by "X" on head.



DRILLED FILLISTER HEAD MACHINE SCREWS

Used in many assembly operations and hence available in several types and a wide range of sizes. Low-carbon screws, for ordinary uses where high strength and close tolerances are not required, made to Air Force drawings AC500A and AC501A. Heat-treated nickel steel screws, for more particular applications where screws are appreciably stressed, conform to Army-Navy drawings AN502 and AC503. For close positions, where double cross-drilling is desirable, nickel steel screws conform to Navy drawing NAF-1164. Plating is bright and uniform. Nickel steel items identified by "X" on head.

We are Specialists . . .

in the manufacture of selected items of aircraft hardware. In addition to the above, we can furnish high-quality Hexagon Head Bolts, Clevis Bolts and Pins, Washer Head Screws, and Threaded Taper Pins.

Write for Catalog and Engineering Data

AERO SCREW COMPANY

19th Ave. at 12th St., Rockford, Illinois

The automatic rudder trim is based on a system first developed for a pre-war de Havilland aircraft, the Flamingo. By means of a spring-loaded telescopic strut link to the trimming tab any load on the rudder caused by yaw from one engine is corrected and the rudder forced over by the tab to offset the external load. Therefore, if one engine fails, the pilot has no call to exert continuous and tiring pressure on the rudder bar to fly a straight course.

As a flying machine, the Mosquito is described by pilots as a sheer delight. The take-off is quick and straight-forward, with no tendency to swing. It climbs well at 200 mph, while in level

flight the Mosquito is brilliant on the controls and can be thrown about with an abandon normally associated with single-engined aircraft. With a full load it will not only maintain height but will climb with one engine without running the latter all-out, and in spite of the single fin and rudder, pilots find no difficulty in keeping the machine straight with one engine stopped and its propeller feathered.

With regard to the Rolls Royce Merlin 21 engine, this is identical with the Merlin 20, except for reversed cooling flow demanded by the leading-edge radiators. The Merlin 20, it may be recalled, was described in *AUTOMOTIVE*

AND AVIATION INDUSTRIES of May 1, 1942; it then developed 1260 hp at 3000 rpm on low supercharger gear at 12,250 ft and 1175 hp on high supercharger gear at 21,000 ft. Its piston displacement is 1647 cu in. It is a 12-cylinder liquid-cooled 60 deg Vee.

The Hawker-Typhoon

(Continued from page 41)

down behind the trailing edge of the wing. The front windshield is of thick bullet-proof glass. On each side of the pilot is a window similar to those of a car, with a small handle to raise or lower it. A long transparent cover extends some 3 to 4 feet behind the pilot. The portion immediately above him is hinged on the port side and can be opened upwards. It can be jettisoned quickly and easily in an emergency. Forward, side and rear views from the cockpit are all good.

Under the instrument panel is the rudder bar with a large foot-actuated wheel in the center for adjusting its distance from the seat.

Despite the thickness of the wing, the breeches of the outer cannon project above the top surfaces of the wings and are enclosed in small metal blisters.

The Typhoon was designed for ease of production in many dispersed small plants and was split into a number of units to facilitate sub-contracting. One section completed before the machine is finally assembled is the tail unit, which is riveted to the fuselage just forward of the leading edge of the tailplane. Both fin and tailpin are cantilever and of all-metal construction. Main and tail wheels all retract, the former inwards and the latter forward into the fuselage. A locking device prevents the under-carriage from retracting until the flaps have been closed, and toe-actuated brakes are provided for landing.

Control of the radio equipment is by press-buttons, similar in effect to those on some domestic radio sets that automatically select wave-lengths. Aerials run from the sides of the fuselage to the tips of the tailplane.

With such high power and consequent torque there is, naturally, some tendency to swing to port during take-off. In addition to setting the rudder trimming tab to starboard, full port bias has to be applied to the rudder bar; also, during take-off the pilot must be careful not to push the control column too far forward, for, even with the tail down, there is only about 20 in. clearance between the propeller tips and the ground.

In the air the Typhoon is said to handle well. For its size and weight it is most maneuverable and pilots say it can be "thrown about" easily in tight turns and vertical banks. Its high wing loading makes the gliding angle steep and with the engine shut off the Typhoon touches down to about 120 mph. The Typhoon wing span is 41 ft 7 in. and the length 31 ft 11 in.

Special LIVE CENTER SET-UP REDUCES SCRAP



on vital
aircraft engine part

Battery of Ex-Cello-O
Thread Grinders Involved
in Operation.

Operator at N. A. Woodworth Co., Ferndale, Mich., putting another part on specially designed Sturdimatic Live Center.

They had trouble with *dead centers*, during a precision grinding operation at N. A. Woodworth Co., because of deep scratching. Emery, in the coolant, was getting between dead centers and a highly polished spherical radius hole, in the part, that was used for support between centers. . . . We designed a special STURDIMATIC LIVE CENTER which, revolving with the part, stopped all movement between the highly polished concentric surface and the center, eliminating the trouble at the source—without any rub-

b^{ing} action, the emery in the coolant had no bad effect. . . . Scrap had been running high—threads had to be ground concentric with the spherical radius hole within very close tolerances and production of thousands per day had to be maintained. So here a substantial saving on a vital war part was accomplished by using a STURDIMATIC LIVE CENTER. . . .

standard shanks with Morse taper carried in stock. . . . send for catalog.

STURDIMATIC

TOOL COMPANY
5226 Third Avenue, Detroit, Mich.
LIVE CENTERS

UPSETTING



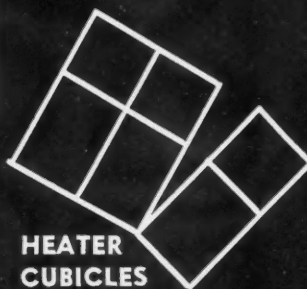
UPSETTING MACHINE



MOTOR CONTROL

600 KW 400 VOLT
1920 CYCLE
MOTOR GENERATOR S

GENERATOR CONTROL



HEATER CUBICLES

20,000 A DAY!

With line production "floating" on conveyors and high frequency heating for forging, 75 and 105 mm shells are put through this plant, from bar stock to packaged shells, at the rate of 20,000 per day.

Ajax-Northrup high frequency heating was chosen because of the short time cycle, small space required, low unit heating cost, freedom from scale and therefore longer life of the dies and less down time for changing tools.

The layout shown above with three heater cubicles, for instance, heats one 105 mm billet every 40 seconds. Five heaters turn out one 75 mm shell every 23 seconds using a 400 kw generator.

Time of heating is automatic. On account of the small heat loss, operators experience little or no discomfort, and the synchronous motors that operate the high frequency generator are of material value in improving the power factor of the entire plant.

The use of Ajax-Northrup equipment for both heating and melting has increased greatly during the past five years. A wealth of experience dating back to the first applications of high frequency in this country is available for priority applications and to a limited extent, for after-the-war planning.

and later on:

Practically all of the equipment in this installation will be readily convertible to automobile forgings, as small as 1" in diameter, when the emergency is over.

It will be possible to heat any section of the bar by changing the taps on the heater.

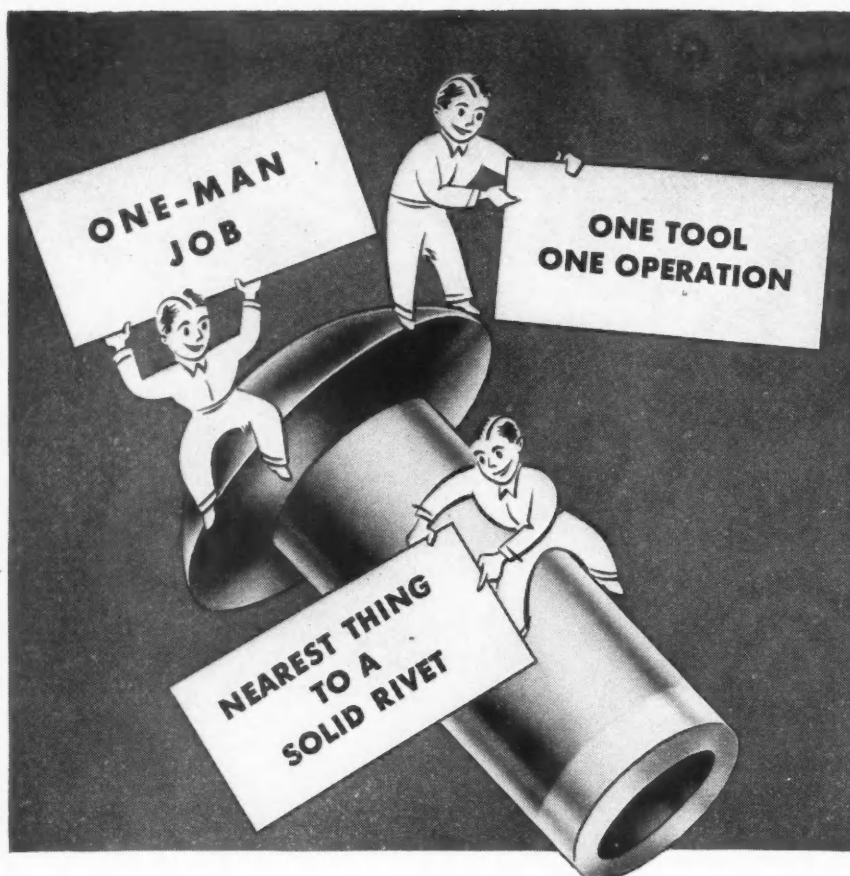
In fact, about 80 per cent of all investments now being made in Ajax heating or melting furnaces can be converted to produce new economies in peace-time efforts.



AJAX HIGH FREQUENCY FURNACES

NORTHUP AJAX ELECTROTHERMIC CORPORATION, AJAX PARK, TRENTON, N.J.

ASSOCIATE COMPANIES: THE AJAX METAL CO. Non-Ferrous Ingot Metal for foundry use. AJAX ELECTRIC FURNACE CORPORATION. Ajax-Wyatt Induction Furnaces for melting. AJAX ELECTRIC CO., INC. Ajax-Hultgren Salt Bath Furnace and Resistance Type Electric Furnaces. AJAX ENGINEERING CORPORATION. Aluminum Melting Furnaces.



3 distinctive advantages OF THIS NEW BLIND RIVET

WHEN there's blind riveting to be done, Du Pont Explosive Rivets offer 3 advantages that help speed up the work and provide assurance of a better completed job.

One man can easily set from 10 to 20 of these rivets a minute.

Only one tool is needed—the Du Pont Riveting Iron.

Just one operation does the job—effectively and quickly.

And you get the nearest thing to a solid rivet that has yet been devised for blind riveting.



EXPLOSIVE RIVETS

THE ONE-PIECE BLIND FASTENER WITH A SOLID SHANK



Today, these rivets are being used by the millions in America's leading aircraft plants and for repair and maintenance work at many airfields. Get the facts about this modern method of blind riveting that saves man-hours, cuts costs and does a better job.

Call or write: E. I. du Pont de Nemours & Co. (Inc.), Explosives Department, 5494-F Nemours Bldg., Wilmington, Del.; 5-236-F General Motors Building, Detroit, Mich.; 5801-F So. Broadway, Los Angeles, Calif.

New Products for Aircraft

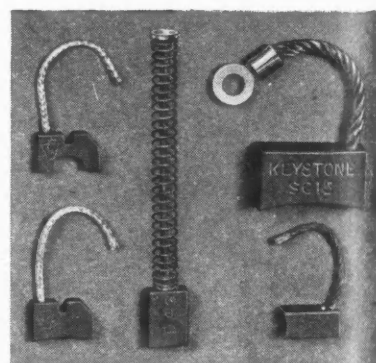
(Continued from page 40)

weight. Both machines are equipped for testing brakes at two speeds, and are adjustable for any width landing gear.

The operating principle of the Bennett-Feragen Aircraft Brake Tester permits duplication of actual brake service conditions and allows brakes to be tested at their maximum capacity. Wheels are cradled between the two pairs of revolving rollers, which are so constructed as to provide friction surfaces equivalent to the tire on dry concrete. The rollers turn the wheels against normal running friction, and, when the brakes are applied, the force required to turn the wheels against the brake resistance is registered on the dials. This reading is the actual braking force existing between the tire and ground surfaces.

Brushes for Ring and Commutator Applications

New grades of brushes for ring and commutator applications for the aviation and electrical industries have been brought out by Keystone Carbon Company, St. Marys, Pa. The accompanying illustration shows a few designs which are made in various grades of copper-graphite and silver-copper-graphite. Certain types were de-



Brushes made by
Keystone Carbon Company

veloped specifically for current control apparatus where extreme precision is vital. The shunts are moulded into the brush and are said to establish a perfect connection. Low contact drop, high current carrying capacity and a low coefficient of friction are inherent characteristics of these brushes.

Power Gun for Cherry Rivets

The Cherry Rivet Co., Los Angeles, Cal., has designed the Cherry Rivet G15 Power Gun for high speed application of Cherry Blind Rivets in double-surfaced structures where ac-

FORMED WHEEL GRINDING ...

*Gears, Splines
and Racks*

EXTERNAL GEARS

INTERNAL GEARS

EXTERNAL SPLINES

INTERNAL SPLINES

RACKS

The Formed Wheel Method of grinding with accurate hardened and ground index plates, enables GEAR-GRIND Machines to meet the exacting requirements of war production. "Hob, harden and grind" eliminates the worries caused by the frequently changed steel specifications resulting from the war.

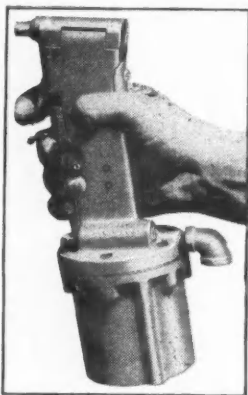
We manufacture GEARGRIND Machines for the Formed Wheel Grinding of external and internal gears, external and internal involute splines, straight splines, racks and serrations. Catalog on request.

GEARGRIND—TYPE GG-19
Model shown grinds up to 10" diameter external gears. Other models handle sizes up to 72", with varying center distances.



The

**GEAR GRINDING
MACHINE COMPANY**
DETROIT, MICH. U.S.A.



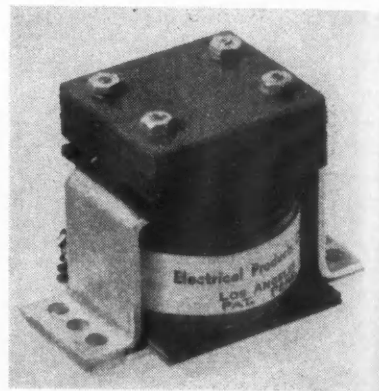
cess to one side of the work is obstructed. It is an all-pneumatic gun with hose connections for 1/4 in. lines, operating on 75 to 100 p.s.i. Three interchangeable pulling heads handle the three standard diameters of Cherry Rivets (1/8, 5/32 and 3/8 in.), either hollow or self-plugging types. The gun weighs 4 1/2 lbs., is 10 1/2 in. high, and has a maximum diameter of 3 3/8 in. Clearance around the rivet axis is 1/8 in. The tool operates equally well in any position.

Cherry Rivet G15 Power Gun

Sealed Chamber Midget Relay

A sealed chamber is one of the features of a midget relay which is now in production at Electrical Products Corporation, Los Angeles, Cal. The sealed chamber serves as an arc quench and reduces fire and explosion hazards. Contacts may be reversed without disturbing adjustment.

While rated at 25 amps., the new



"Sealed Chamber" "Midget Relay" made by Electrical Products Corporation.

relay is said to operate satisfactorily at 50 amps., and to have been tested without failure at 120 amps. high inductive load. It has withstood Army tests including overload, vibration at 55 cycles per second with .060 in. excursion, acceleration of 10 gravity units, and salt spray tests of 240 hrs. duration.

Vega Simplifies Production

(Continued from page 21)

simulate the shape of the jig in miniature and are proportioned to hold one day's supply of parts. Thus, the breaking-in time for a crew at a station or jig is reduced considerably.

This type of organization is strictly an "area-wise" organization with "area-wise" responsibilities. Operating within the assigned departments and with the responsibility of performing methods work through an operating responsibility, it has been possible to quickly solve departmental difficulties.

Also, as the groups established on this "area-wise" basis have become acquainted with the problems of their departments, they have been able to foresee difficulties, so that operating problems are now being dealt with before they become acute. Tooling difficulties are diminishing, as the tools which are being designed now are made to conform to current departmental requirements. Thus, when these tools are built and are brought to the department where they were planned, the corrective work required by them is negligible. Standardization of work for all models is automatically accomplished through the efforts of the section engineer.



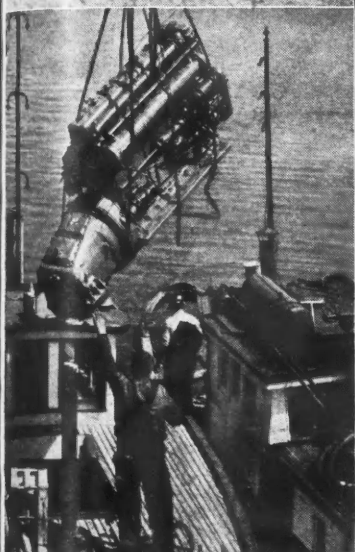
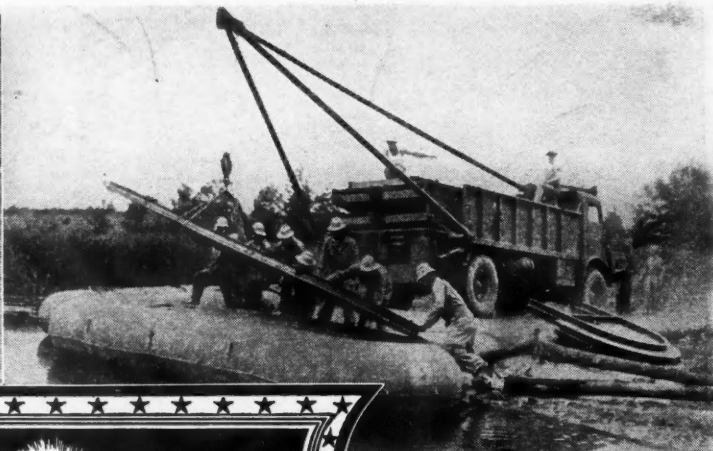
Announcing
DELIVERY DATES
on all TURNER GAUGES


★ PLUG ★ FLUSH PIN ★ RING
★ BUILT UP ★ SNAP

Because all magazine advertising has to be prepared far in advance of publication dates, we feel that in all fairness to manufacturers no definite delivery dates should be published in our advertisements. For up-to-the-minute delivery promises on the above gauges we urge you to write for our TURNER BULLETIN, which is issued each month in advance of our advertising. Send for it today!

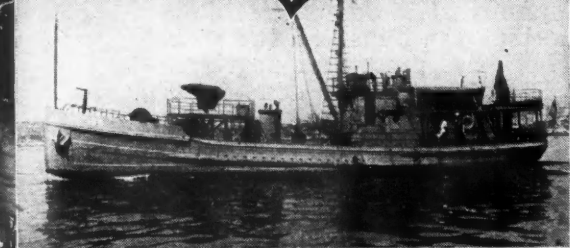
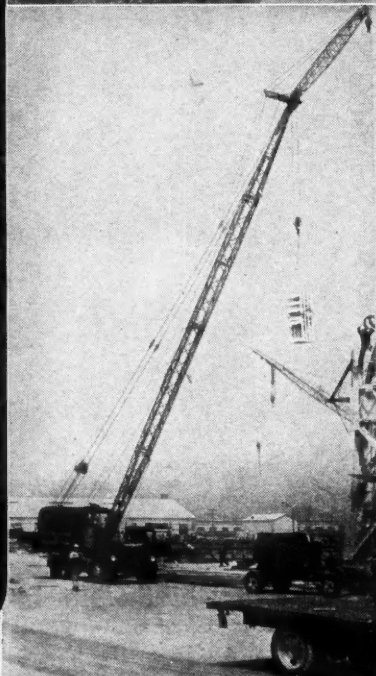


TURNER GAUGE GRINDING COMPANY
2622 HILTON ROAD • • • • • FERNDALE, MICH.

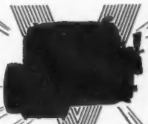


YOUR  UNCLE

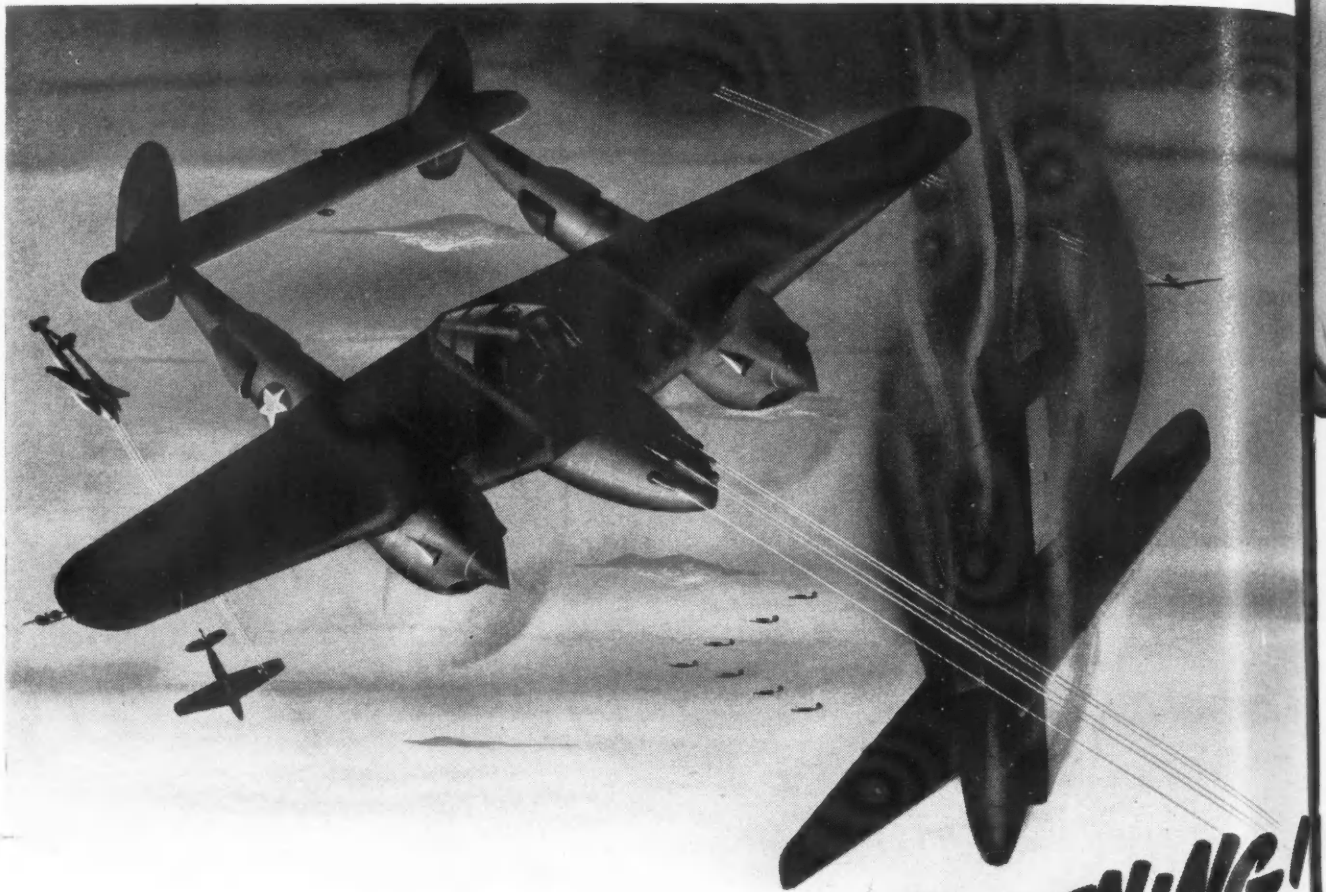
has a highly mechanized war on his hands... with many new, and unheard-of power problems. To produce Waukesha Engines that will help solve them *quickly*, Waukesha Engineers have put to work *all* their imagination, ingenuity, experience and facilities. After Victory, that effort will produce better engines for your post-war needs.



WAUKESHA MOTOR COMPANY, WAUKESHA, WIS., New York, Tulsa, Los Angeles

MORE POWER  FOR VICTORY

WAUKESHA ENGINES

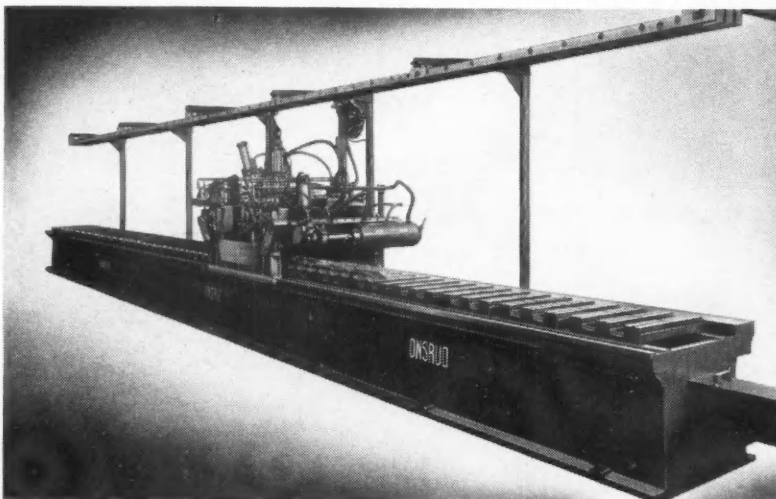


to help hit the Axis with

LIGHTNING!

Helping to hit the Axis by helping Lockheed to build planes faster are many unusual Onsrud production machines—among them the Onsrud Automatic Contour Milling Machine. On this single machine are milled all the spar beams and cap strips that Lockheed production requires. Work formerly requiring 30 hours is now done in 6 minutes.

Complete facts on the scope of this famous milling machine, today the favorite of America's prime aircraft builders, are available to all production executives. Write—Onsrud Machine Works, Inc., 3925 Palmer Street, Chicago, Illinois. Sales Offices in all Principal Cities.



Large cutting capacity, non-trapping cutter control, automatic variable feed control, automatic twist cut heads, are a few of the A80 features.

This machine is fully protected by patents issued and pending. All infringements of our rights will be diligently prosecuted.



Free!

HERE IS HOW

YOU MAY OBTAIN YOUR COPY

This new Muskegon Aircraft Piston Ring Manual is available to anyone with a legitimate interest in servicing aircraft engines. Crammed with authentic data and profusely illustrated, it is a comprehensive study of the piston, ring and cylinder phases of aircraft engine rebuilding.

In requesting your free copy please state your position or activity prompting your interest.

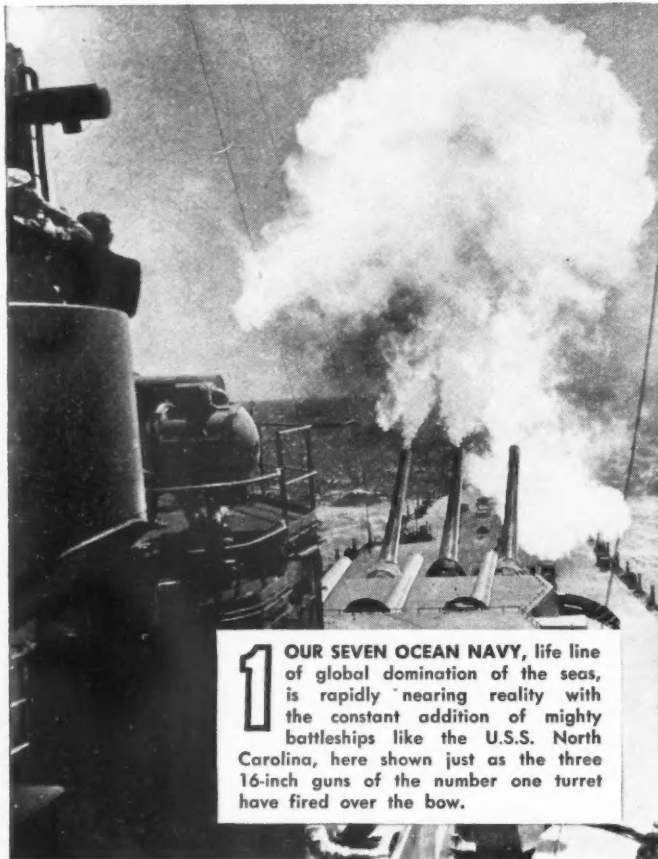
MUSKEGON PISTON RING CO.

MUSKEGON, MICHIGAN

PLANTS AT MUSKEGON AND SPARTA



FAMOUS LIFE LINES



1 OUR SEVEN OCEAN NAVY, life line of global domination of the seas, is rapidly nearing reality with the constant addition of mighty battleships like the U.S.S. North Carolina, here shown just as the three 16-inch guns of the number one turret have fired over the bow.

Official U. S. Navy Photograph



2 PRACTICALLY EVERY U. S. ARMY VEHICLE, like this truck plowing through the mud roads of Iceland, is helped to "keep rolling" by life lines of Bundy Tubing—gas lines, brake tubes, oil lines, hydraulic controls, and an average of more than fifteen other tubing parts.

Photo by U. S. Army Signal Corps

WITHIN EVERY SHIP of our mighty Navy—in every Army vehicle, in every plane that flies—are humble, but *vital*, life lines of metal tubing.

They provide the pressure that turns tank turrets. They feed Diesel engines. They keep powder cool. They power the brakes on trucks and jeeps.

These life lines are Bundy's contribution to Victory.

Wherever fuel and lubricants must flow, wherever vacuums must be created or hydraulic pressure trans-

mitted—there is Bundy Tubing. You find it even in the lamps of Army surgeons; and in the rip cord grips of parachutes.

Bundy Tubing is now used for some 5,000 parts in the vehicles, weapons and equipment of our armed forces—at sea, ashore and in the air.

The list is growing steadily. And Bundy plants, which have tripled their output in the past two years, stand ready to meet new demands as they may come. Bundy Tubing Company, Detroit.

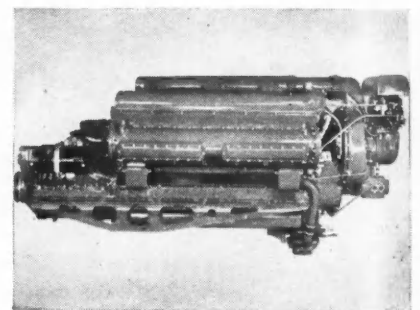
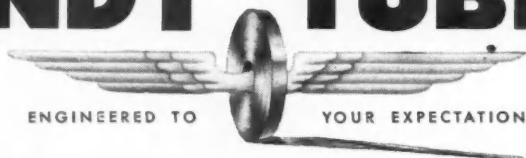


Photo Courtesy Packard Motor Car Co.

MARINE ENGINES FOR SMALL CRAFT—Engines for the Navy's smaller craft—PT Boats, landing barges and "crocodiles"—have many "life lines" of Bundy Tubing, such as primer tubes, Diesel injector tubes, fuel and lubrication lines, and hydraulic control tubes.

BUNDY TUBING



BUNDYWELD double-walled steel tubing, hydrogen-brazed, copper-coated inside and outside. From Capillary sizes up to and including $\frac{1}{16}$ " O. D. This double-walled type is also available in steel, tin-coated on the outside, and in Monel.



BUNDY ELECTRICWELD steel tubing. Single-walled—butt welded—annealed. Available in sizes up to and including 2" O. D. Can be furnished tin-coated outside in smaller sizes.

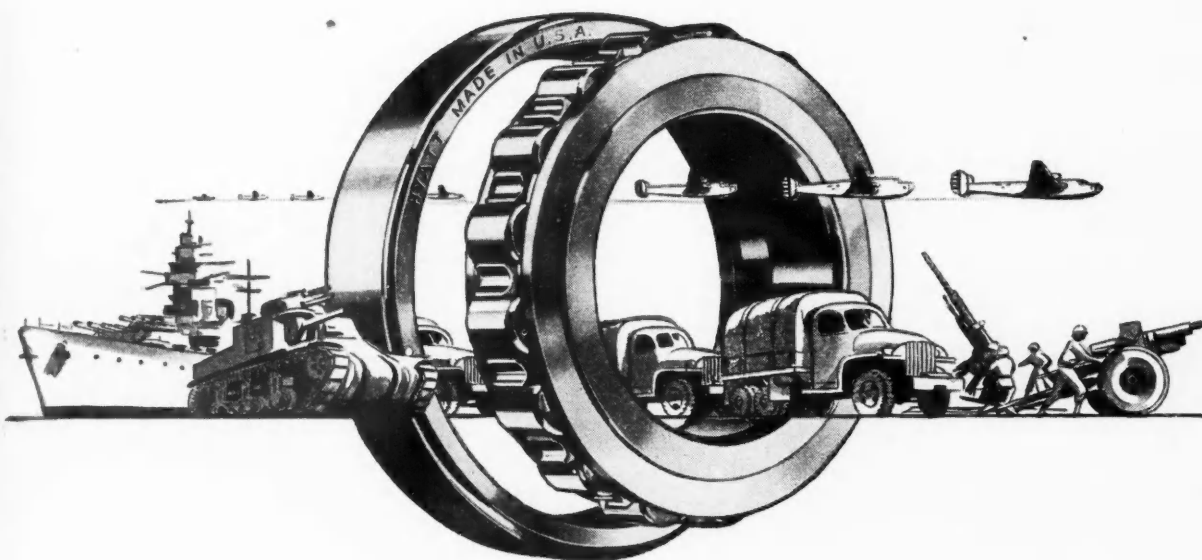


BUNDY "TRIPLE-PURPOSE" tubing. Double-walled, rolled from two strips, joints opposite, welded into a solid wall. Available in all Monel; all steel; Monel inside—steel outside; Monel outside—steel inside. Sizes up to and including $\frac{3}{8}$ " O. D.

Buy U. S. War Bonds
Get in Your Scrap

Keeping Them Rolling—

Our Job Yesterday, TODAY and Tomorrow!



TODAY the heavily loaded shafts, gears and wheels of vital war equipment turning on Hyatt Roller Bearings, are well protected against shocks, excessive wear and breakdowns.

And other smooth rolling Hyatts, of the same microscopic accuracy and unyielding stamina, are serving round-the-clock in the machines which help build mighty guns and planes and tanks and ships.

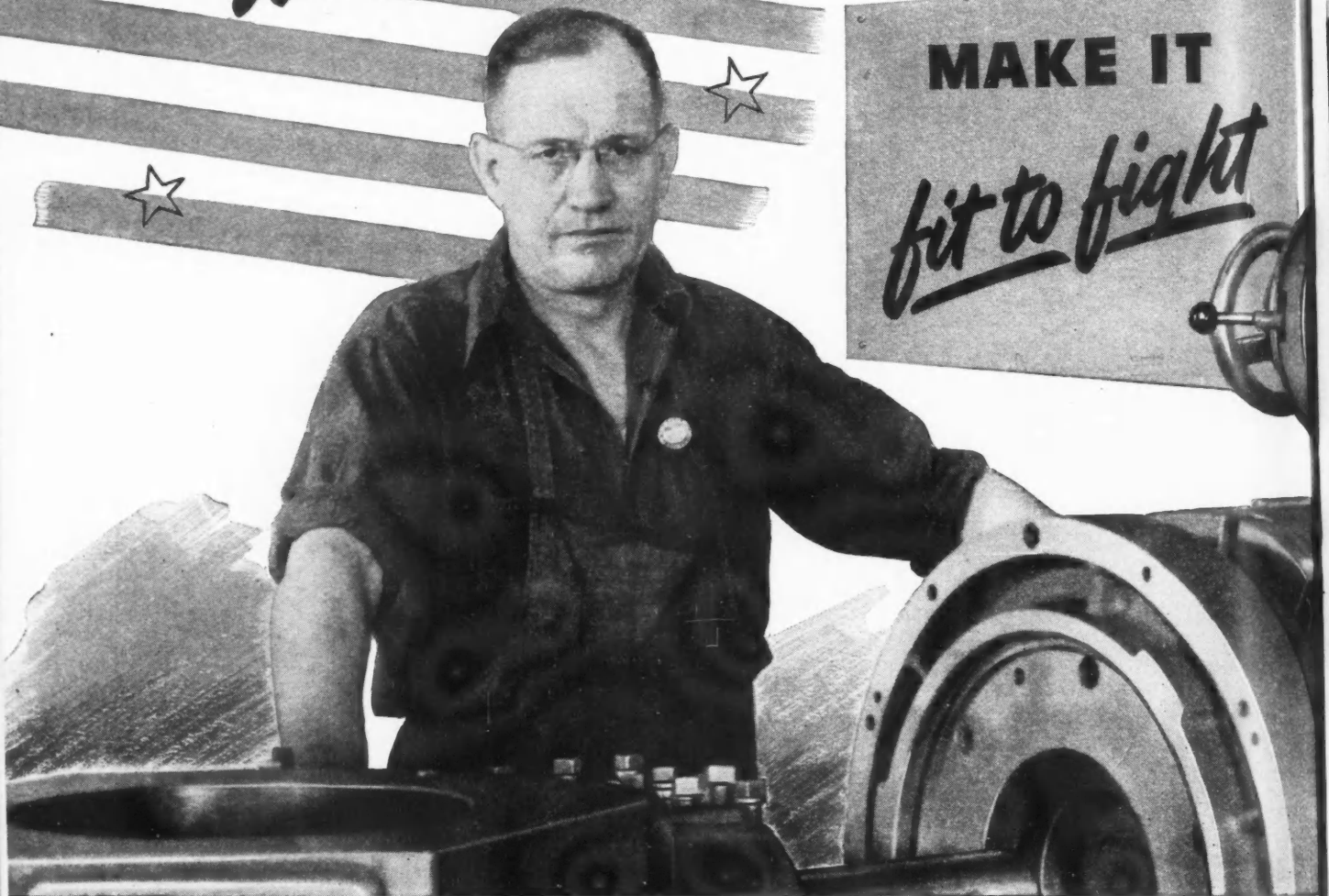
Prolonging machine life...keeping equipment going... has been a job done well by Hyatts for the past fifty years. And after this war's won, there will be many more industrial, agricultural and transportation bearing applications in which Hyatts will continue to serve and save for another half century.

Is there any way we can help you now? Hyatt Bearings Division, General Motors Corporation, Harrison, N. J.



HYATT ROLLER BEARINGS

*I'm fighting
in my own way!*



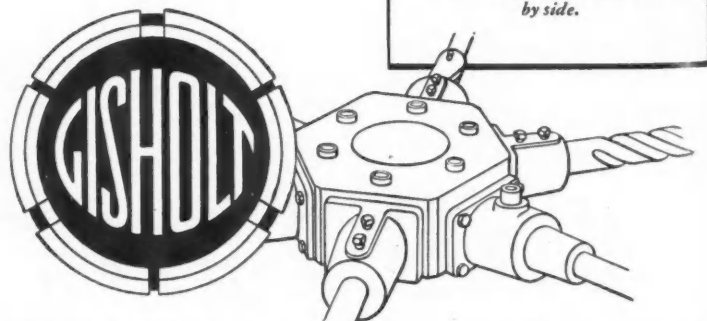
TOO OLD to carry a gun? Well, maybe! But not too old to fight for a decent world for my grandson to live in.

I fight with the weapons America understands best—machine tools, mass production—interchangeable parts!

I make this part over and over again. It's always the same—always accurate, so that on assembly line or in the repair shop, the parts always fit—precisely!

My Gisholt and I will keep at it—making parts that are *fit to fight*—until the last shot has been fired.

GISHOLT MACHINE COMPANY
12 5 East Washington Ave., Madison, Wis.



At Gisholt, the Army-Navy "E" and the Treasury Flag fly side by side.

★ **Look Ahead!!! Keep Ahead!!! With Gisholt Improvements in Metal Turning** ★
TURRET LATHES • AUTOMATIC LATHES • BALANCING MACHINES



OWI Photo by Palmer, in an Allegheny Ludlum plant.

Save . . TO PRODUCE MORE

★ *The nation needs scrap iron and steel—millions of extra tons of it this year. Make your clean-up complete, both in the plant and at home. Subject every pound of idle metal to the searching question: "Is it absolutely essential that we keep this?"*

But don't stop there! Rounding up the scrap and instituting more thorough salvage methods are only part of the job of conserving the nation's resources. Start at the beginning and make better use of *new* steel . . . aim to get more finished products out of it, with less waste.

That is particularly necessary with electric-furnace steels, and the critical alloys they contain. There are many ways to save. Both stainless and tool steels can be more efficiently selected and better used, to step up production and cut down the amount of rejects and spoilage. The substitution of lower alloys, and of standard analyses, sizes or finishes instead of special ones, all offer good opportunities to save.

Right now, do your share to increase the nation's scrap stockpile. And for the duration, avoid waste

in all its forms—*make every pound of steel and alloys go as far as possible.* If you run into problems, call on our Technical Staff to help you.

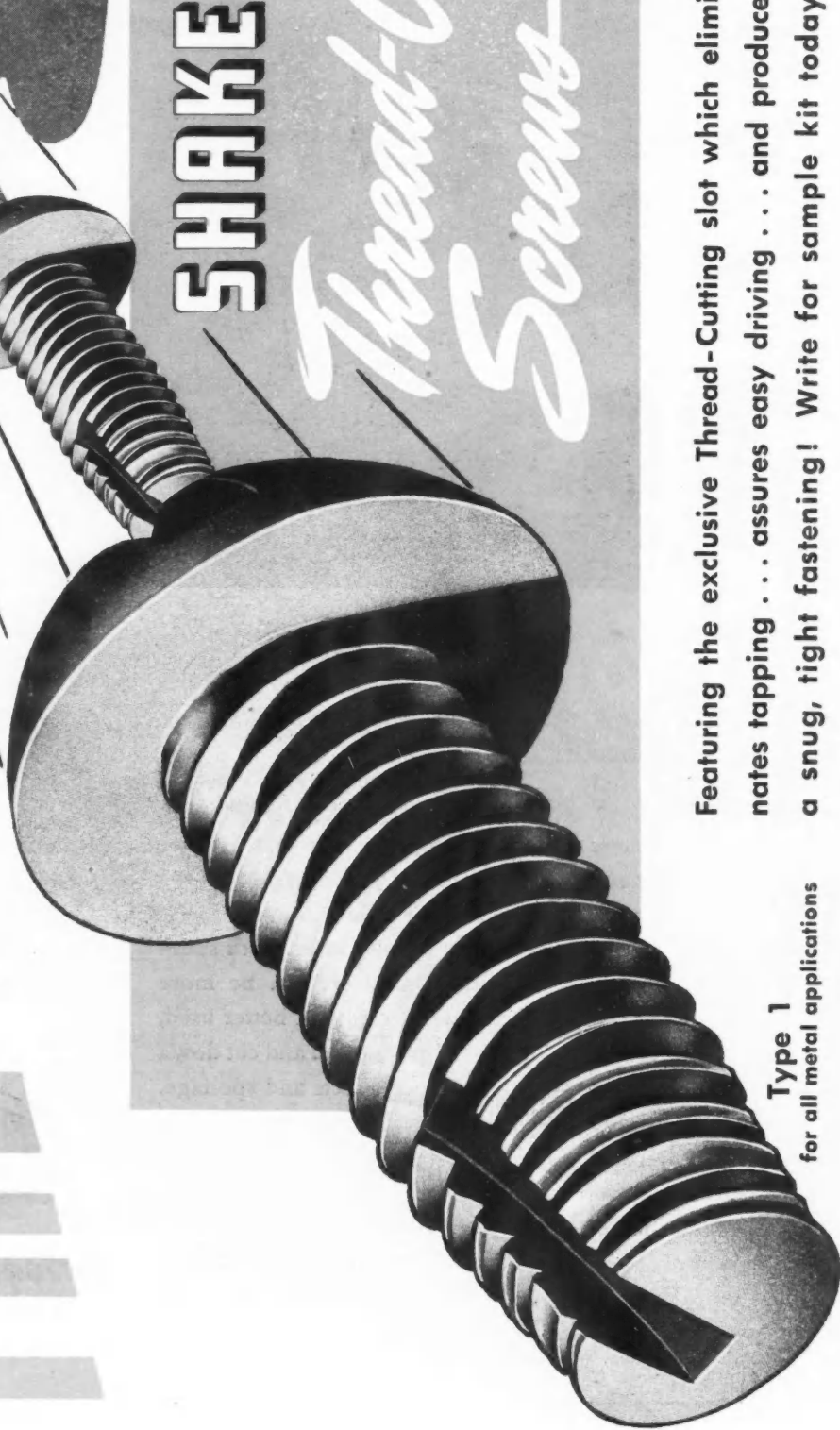
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Allegheny Ludlum
STEEL CORPORATION
BRACKENRIDGE, PENNSYLVANIA

A-8866 . . . W & D

THE SPEED YOU NEED!



SHAKEPROOF

Thread-Cutting Screws



Type 1
for all metal applications

Featuring the exclusive Thread-Cutting slot which eliminates tapping . . . assures easy driving . . . and produces a snug, tight fastening! Write for sample kit today!

**FREE
TEST KIT!**

SHAKEPROOF inc.

DISTRIBUTOR OF SHAKEPROOF PRODUCTS MANUFACTURED BY ILLINOIS TOOL WORKS
2501 North Keeler Avenue, Chicago, Illinois
Plants at Chicago and Elgin, Illinois • In Canada: Canada Illinois Tools, Ltd., Toronto, Ontario

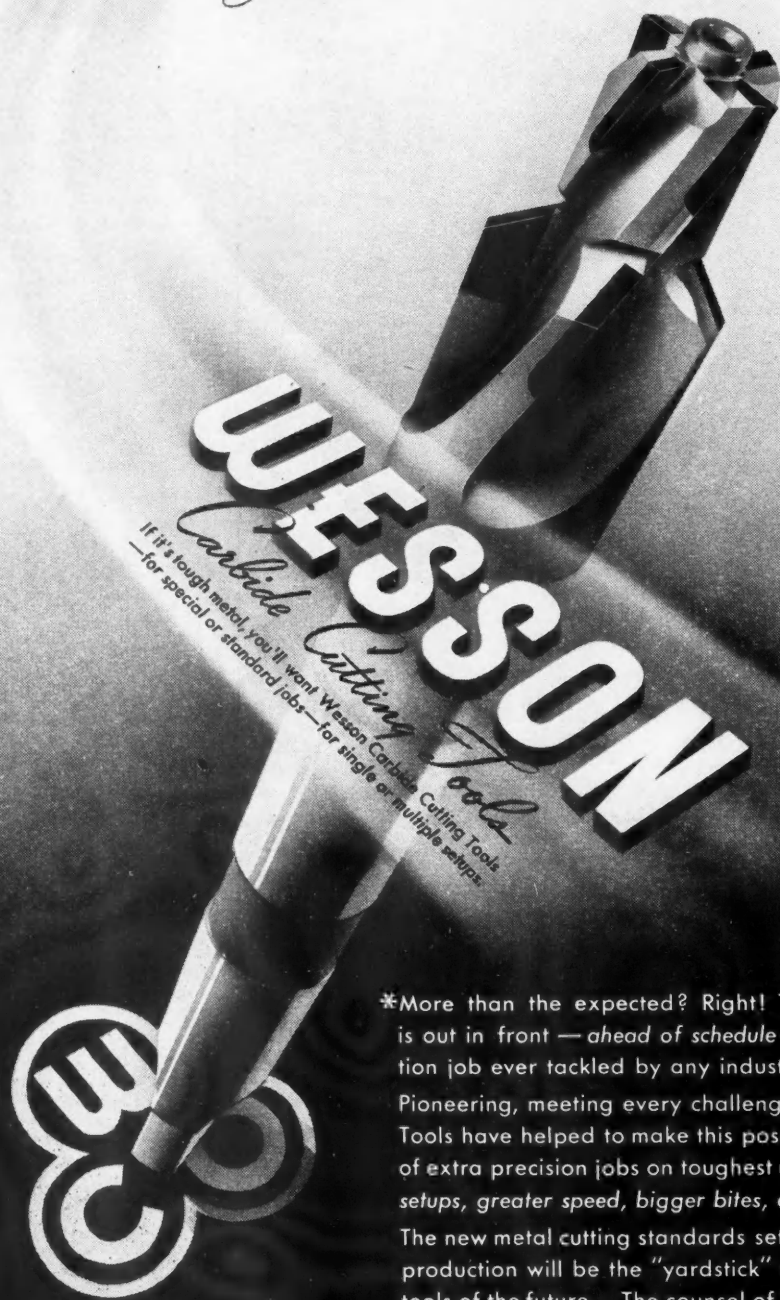
IN
safer
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and

June

HELPING THE

Aircraft Industry

DO MORE THAN
THE EXPECTED*



*More than the expected? Right! Today our Aircraft Industry is out in front — ahead of schedule — and the biggest production job ever tackled by any industry is practically "licked."

Pioneering, meeting every challenge, Wesson Carbide Cutting Tools have helped to make this possible — by making short work of extra precision jobs on toughest metals and alloys — with fewer setups, greater speed, bigger bites, and a minimum of rejects.

The new metal cutting standards set by Wesson in aircraft motor production will be the "yardstick" of performance for machine tools of the future... The counsel of Wesson engineers — skilled in engineering and designing of cutting tools — is available to help solve present war production problems, or for post-war planning.

WESSON CO., DETROIT, MICH. (Ferndale Station)

IN HAPPIER DAYS TO COME we will all have better, safer automobiles — more efficient refrigerators, washing machines and vacuum cleaners... farmers will have better, stronger tractors and other tools and machines... aircraft will continue to set new

standards in speed, comfort and safety... all made possible, in part, by the Wesson development of Carbide Cutting Tools to such high standards that they cut tougher metals than ever before — with greater precision — and at greater speed.



These Sentries Also Serve

"Submarine on the starboard bow!" A whole ship galvanized into action. Blinker lights flash from ship to ship in the convoy of priceless materials of war.

Deck guns sweep into action and the crew prepares depth bombs for a royal welcome to Herr Schicklgruber's emissaries.

The engine room gets the signal for all the speed her straining diesels can squeeze out, and the battle is on. But below deck there are sentries, too—guarding these vital engines, permitting the use of every ounce of power with safety. These sentries are inanimate assemblies of precision equipment—Sylphon Diesel Engine Controls that prevent engine overheating, warn of any serious drop in lubricating oil pressure.

Sylphon Marine Controls for fighting and commercial ships—for diesel and steam ships—are many, varied. They include the regulation of heating, ventilating and

refrigeration; fresh water heaters; fuel oil heaters; lubricating oil temperatures; diesel engines; de-superheaters; steam jet ejector condensers, etc., etc.

These services, the importance of which is only emphasized by the war effort, will continue to be "well-manned" by Sylphon Equipment in the great new American Merchant Marine of the post-war era.



Sylphon Products include: *Aircraft Controls*—Engine Thermostats, Oil Cooler Thermostats, Fuel Pressure Regulating Valves; Parts for Supercharger Controls, Carburetor Controls, Fuel Injector Controls; *Marine Controls*—for the Regulation of Fresh Water Heaters, Fuel Oil Heaters, Lubricating Oil Temperatures, Diesel Engines, Desuperheaters, Steam Jet Ejector Condensers; *Automotive Controls*—Engine Temperature Controls for Tanks and Other Military Vehicles, Trucks and Passenger Cars; *Refrigeration Controls*—Thermostat Mechanisms for Domestic and Commercial Refrigerators; *Industrial Controls*—Temperature, Pressure and Vacuum Controls for Industrial Processes; *Air Conditioning Controls*—for Buildings, Ships, Railroad Trains, Aircraft.



THE FULTON
KNOXVILLE,

SYLPHON CO.
TENNESSEE

Temperature Controls... Bellows... Bellows Assemblies

**Deep Drawn Bomber Parts are
Turned out Quickly at the
FORD Willow Run Plant on**

HPM

FASTRAVERSE PRESSES

**with New 6 Point
Variable Pressure
Blankholder Ring**

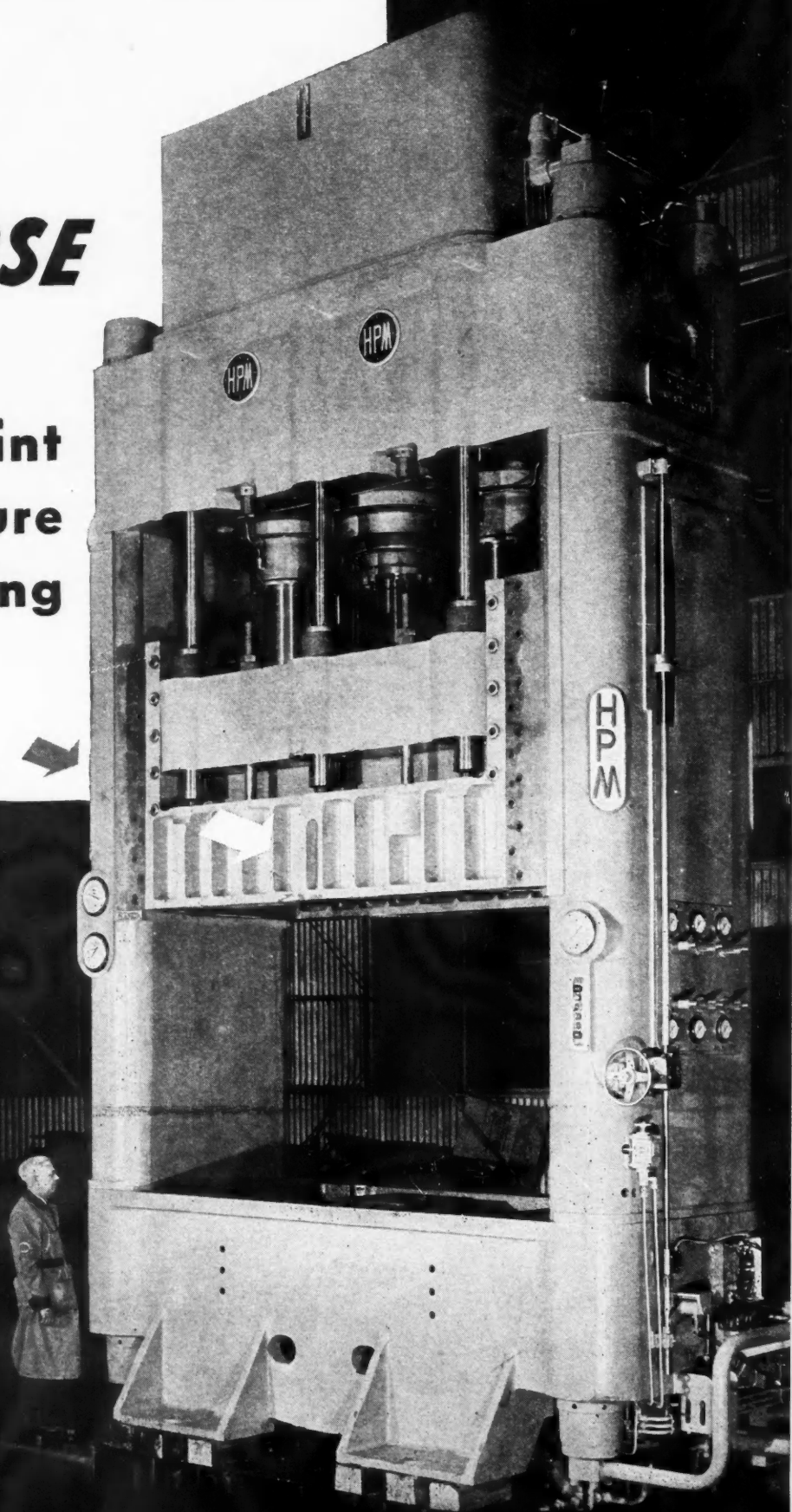
Employing the HPM Closed Circuit system of shockless operation, these large HPM Fastraverse Blankholder Presses with variable 6 point pressure ram resistance on the periphery of the blankholder ring are especially adaptable to the deep drawing of large aircraft parts. The pressure of each of the six blankholder rams can be adjusted individually and independently. Separate hydraulic die cushion fitted into the press bed can also be used as an ejector, when desired. The two slides locked together give single action service increasing the maximum pressure capacity to 1000 tons. Investigate this versatile press for both present and future deep drawing requirements. » » »

THE HYDRAULIC PRESS MFG. COMPANY
Mount Gilead, Ohio, U. S. A.

District Sales Offices: New York, Syracuse, Detroit and Chicago. Representatives in Principal Cities.

Pressing Member	Main Slide	Blankholder Slide	Die Cushion Platen
Pressure Capacity (tons-net)	750	300	125
Pressing Surfaces (L-R x F-B)	105"x38"	120"x60"	90"x40"
Daylight Openings (Max.)	114"	96"	10"
Main Slide to Bed	42"	27"	10"
Blankholder Slide to Bed			
Ram Travel (Max.)			

The dependable long life HPM HYDRO-POWER Radial Pump powers every HPM Hydraulic Press.





These Sentries Also Serve

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THE FULTON
KNOXVILLE,

SYLPHON CO.
TENNESSEE

Temperature Controls... Bellows... Bellows Assemblies

**Deep Drawn Bomber Parts are
Turned out Quickly at the
FORD Willow Run Plant on**

HPM

FASTRAVERSE PRESSES

**with New 6 Point
Variable Pressure
Blankholder Ring**



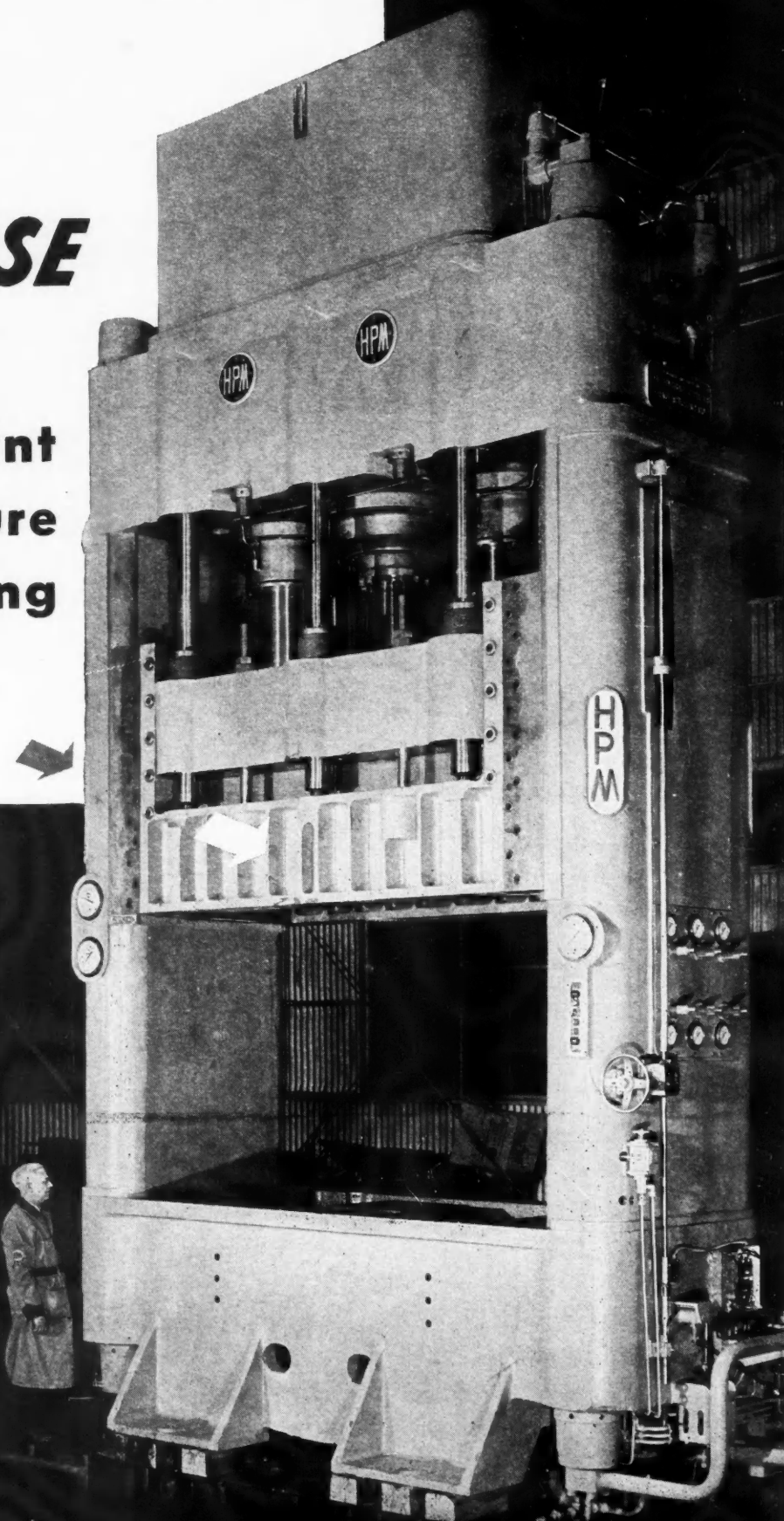
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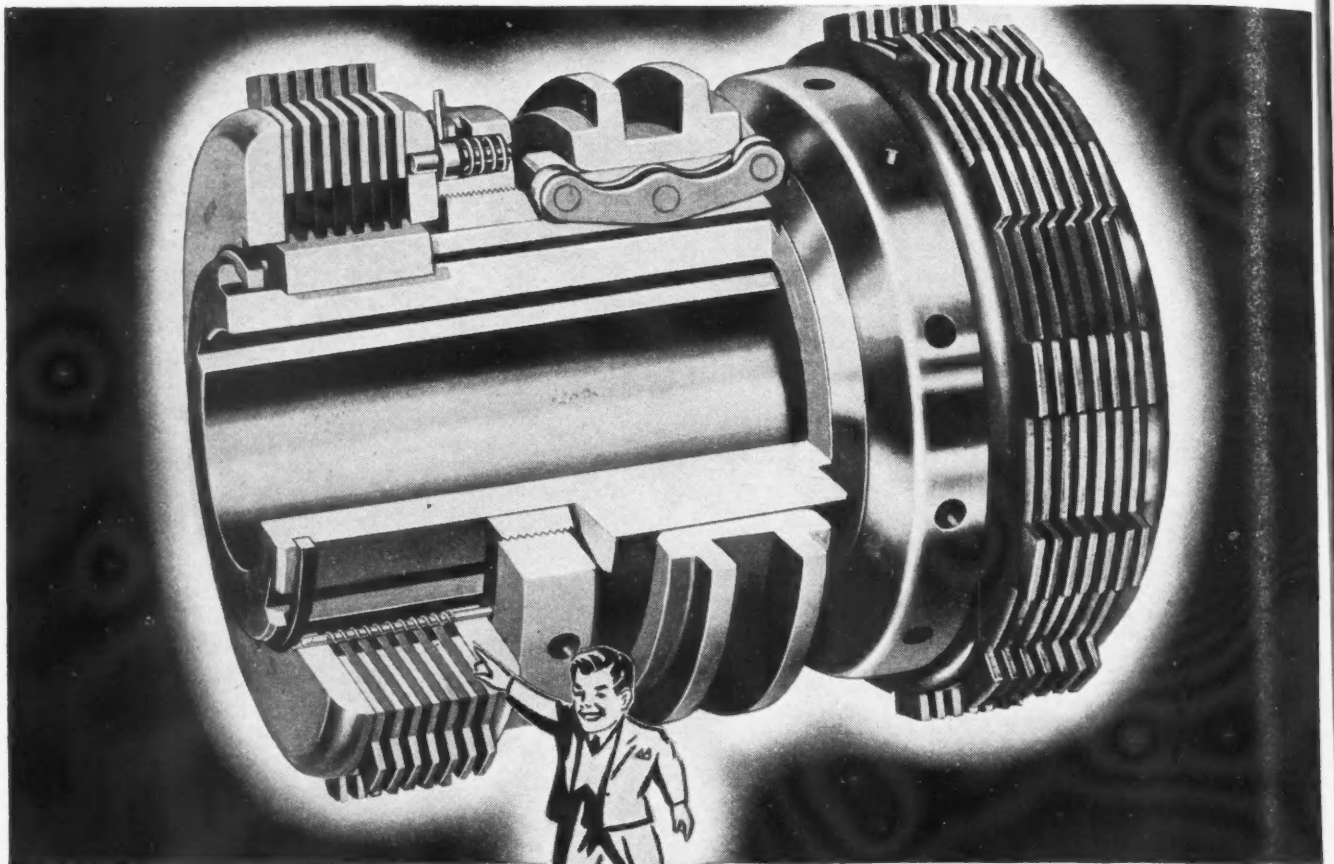
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Mount Gilead, Ohio, U. S. A.

District Sales Offices: New York, Syracuse, Detroit and Chicago. Representatives in Principal Cities.

Pressing Member	Main Slide	Blankholder Slide	Die Cushion Platen
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The dependable long life HPM HYDRO-POWER Radial Pump powers every HPM Hydraulic Press.

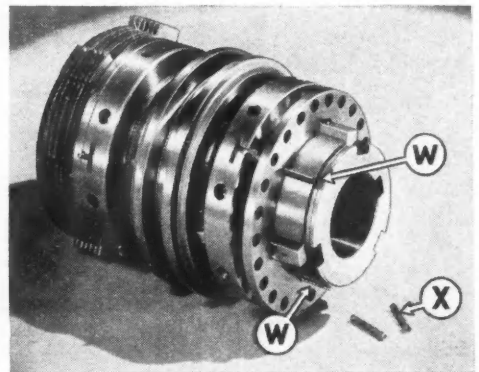




No Loose Springs

Note how the pins fully support the release springs in Twin Disc MTU Clutches. This eliminates any tendency of the spring to bow due to centrifugal force while the clutch is in motion. It likewise prevents any possibility of a spring coil getting between the friction plates as the clutch is engaged. This feature adds to the quick release of the clutch plates, when the pressure is removed, and increases the wear-life of the springs.

TWIN DISC CLUTCH COMPANY, Racine, Wisconsin.



The release springs (X) accelerate the quick release of the clutch and are mounted on solid pins (W) so that they definitely clear all of the clutch plates. These pins hold the springs in proper position.



ENGINE VALVE COVER

NOTE 1: Parts to be machined to $\pm .002$

NOTE 2: To be Aluminum Alloy 24S

NOTE 3: To be finished in accordance with Army and Navy Specifications AN-QQ-A-696-a

"What's meant by that?"

ALCOA HAS THE ANSWER

There are several Government-approved oxide-coated finishes for aluminum, which may be applied by the Alumilite* process. Each has its own identifying symbol and name. You'll certainly run across them in your war work, if you're making aluminum plane or instrument parts which require protective finishes.

Some of these finishes serve as base coatings for paint, providing surfaces to which the paint is highly adherent. All offer increased resistance to corrosion. Some look like uncoated aluminum.

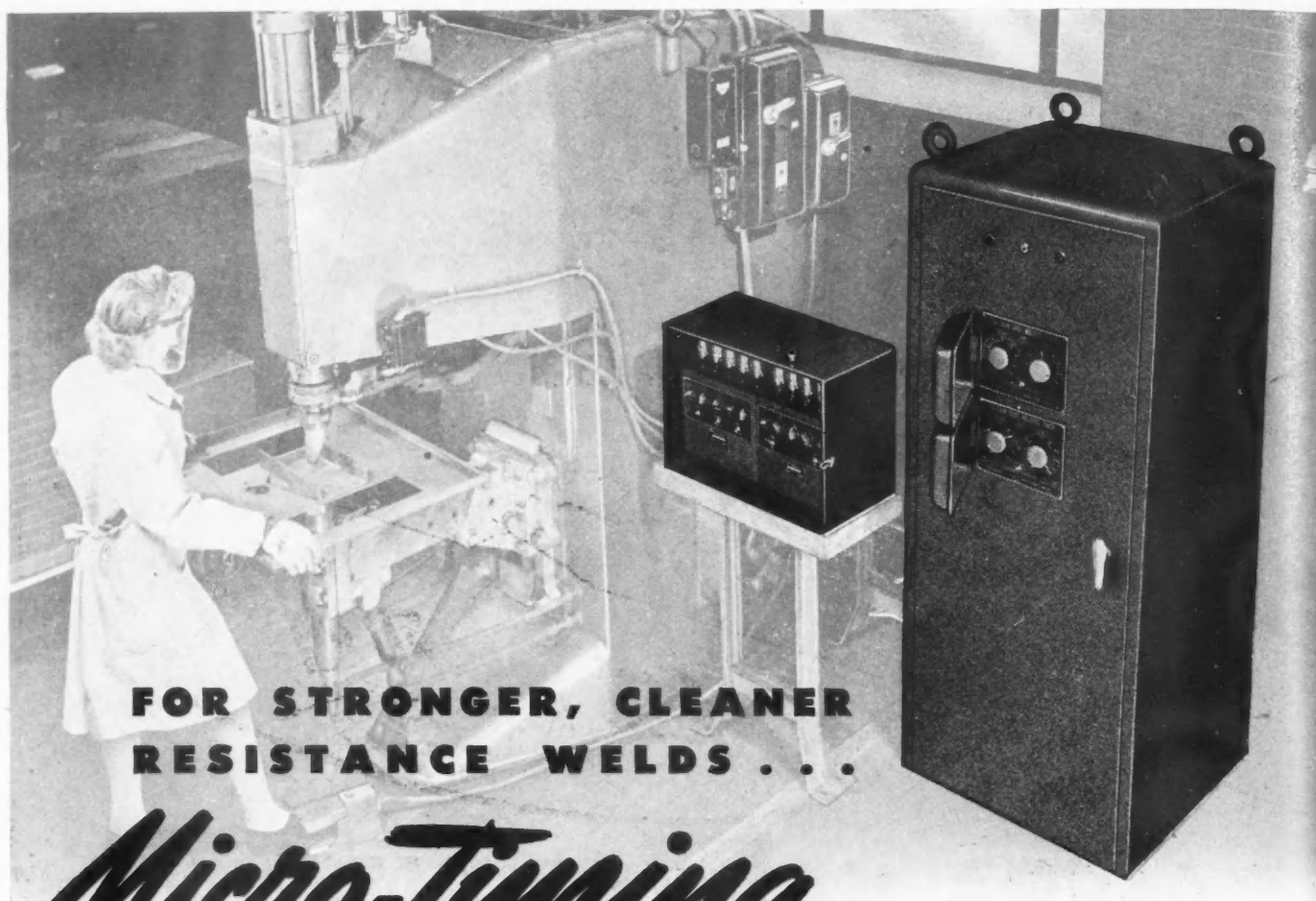
*Patented process

Some are colored or black.

If you are stymied by lack of information on Alumilite finishes—what their symbols and names mean, where the finishes should be used, how they are applied—get in touch with us.

Or, if you're puzzled with some question about aluminum alloys and their fabrication, come direct to us, too. Alcoa engineers have spent a lifetime finding the answers to just such questions. ALUMINUM COMPANY OF AMERICA, 2110 Gulf Building, Pittsburgh, Penna.

ALCOA  ALUMINUM



**FOR STRONGER, CLEANER
RESISTANCE WELDS . . .**

Micro-Timing BY ELECTRONIC CONTROL



**LIKE THE MAN ON THE
FLYING TRAPEZE . . .**

. . . synchronization is important to the control of resistance welding current. Especially on short-time welds of a few cycles, random closing of the circuit produces an undesirable variation in weld quality. Synchronous Control starts and stops weld current at the right point of the wave . . . produces high-quality welds of uniform spot size and strength.



**Westinghouse
ELECTRONICS**

Precision timing with electronic control splits seconds into sixtieths and smaller. Resistance welds are sounder, surfaces are less affected and electrodes last longer, give more spots per cleaning.

Westinghouse supplies all the necessary equipment for electronic control of resistance welding. A typical installation, (shown above) uses two Westinghouse units to control a spot welder which handles work up to $\frac{3}{4}$ " in thickness.

1. **SEQUENCE TIMER** controls the sequence of electrode operations—opening and closing them for preset periods accurate to within one cycle or $\frac{1}{60}$ th of a second.
2. **COMBINATION SYNCHRONOUS TIMER** combines three separate Westinghouse controls in one compact, floor model. **WELD-O-TROL** makes and breaks heavy welding currents as high as 10,000 amperes without flash or noise. **HEAT CONTROL** regulates the heat supplied to the weld from 20 to 100%. **SYNCHRONOUS CONTROL** assures that the power circuit is always closed at the same point on the voltage wave so as to prevent transients which cause uneven welds.

These precision controls save critical materials and increase weld production. Rejects are fewer, welds are faster, more consistent. Ask your Westinghouse representative how electronic control can increase your war production. Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., Dept. 7-N.

J-21273

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE



R E S I S T A N C E W E L D I N G C O N T R O L

Col. Huntington Sends the Gremlins Home...



Time was heavy on their hands because they found that most of our aircraft is equipped with ADEL line supports, ADEL anti-icing systems and ADEL hydraulic equipment, all immune to static howls, Jack Frost nips, control irregularities and similar sly tricks of which Gremlins are so fond.

While we hope they had a nice visit here we feel sure they'll enjoy being released from the advertising columns of many of our publications in which they were called on to do so much over-time work. We suggest that when they get home the R.A.F. flyers give them plenty of nice rich cream. The Irish say that if you keep them full of cream they'll play no pranks . . . it's the next-best thing to Gremlin-proof equipment.

HUNTINGTON

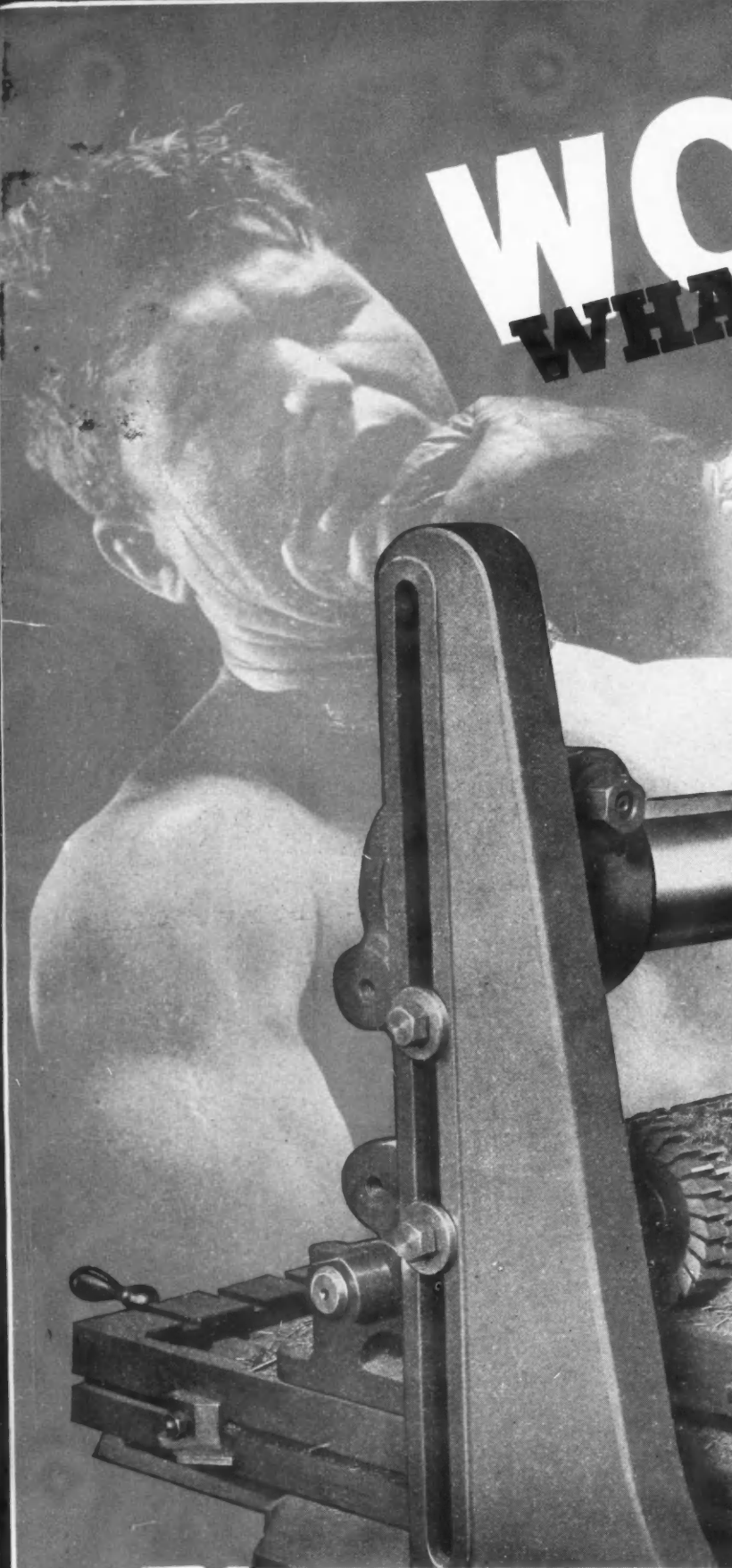
PRECISION PRODUCTS

Division of ADEL PRECISION PRODUCTS CORP.
HUNTINGTON, WEST VIRGINIA



BUY More
U.S. BONDS

Engineering Offices . . . BURBANK, CALIFORNIA • DALLAS, TEXAS
DETROIT, MICHIGAN • HAGERSTOWN, MARYLAND • TORONTO, CANADA



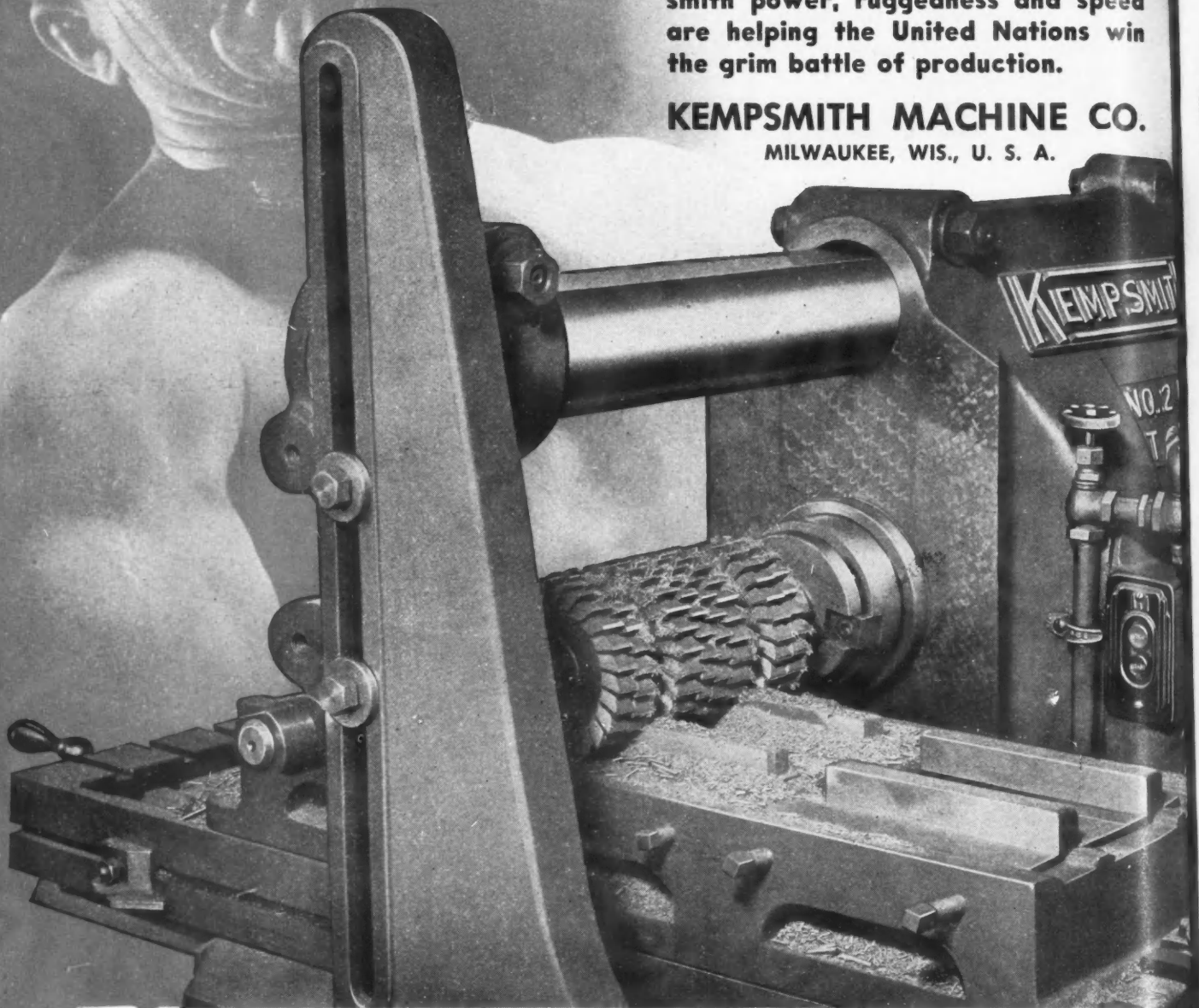
WOW!

WHAT A WALLOP!

For 55 years, Kempsmith Milling Machines have proven their ability to "take it on the chin" and come back for more punishment. Today, Kempsmith power, ruggedness and speed are helping the United Nations win the grim battle of production.

KEMPSMITH MACHINE CO.

MILWAUKEE, WIS., U. S. A.



KEMPSMITH

• Precision Built Milling Machines Since 1880



SINGLE RESPONSIBILITY

Every step in building a Fuller Transmission is handled in Fuller's own plant . . . forging, gear cutting, precision gear mating, assembling and testing . . . that's why you'll find the name *Fuller* stamped on all genuine Fuller gears. Look for the name . . . it is your assurance of a smooth running gear . . . and, of course, smooth running means more wear life, less need for service and parts replacements.



FULLER MANUFACTURING COMPANY • • KALAMAZOO, MICHIGAN



FORTUNE-TELLING IN A FLASH

There's a spark and a puff of burning vapor—it's over in a flash. But while the bit of metal burned, a lens clicked. A picture was taken of its past, present and future.

On the film, made in an instant, is a record of the elements in the sample. American Hammered engineers study that picture and know what was in the metal they burned—and what kind of piston rings it would have made. They know whether rings made of that metal will last for hundreds of grueling hours in the engines of a Flying Fortress... How they will stand up in a tank on the African desert.

★ ★ ★ ★

American Hammered rings have been contributing to

faster and more powerful planes ever since World War I—have played their part in establishing practically all important records and accomplishments in the air. When the war call came, for piston rings that were a year ahead of the planes then in the air, American Hammered was ready!

No one factory could make aviation rings in the enormous quantities needed for United Nations' plane production. It is fortunate that A-H patents, methods, processes—even special micro-finishing equipment—could be shared with other piston ring manufacturers. Shared for combined war production.

American Hammered Piston Rings

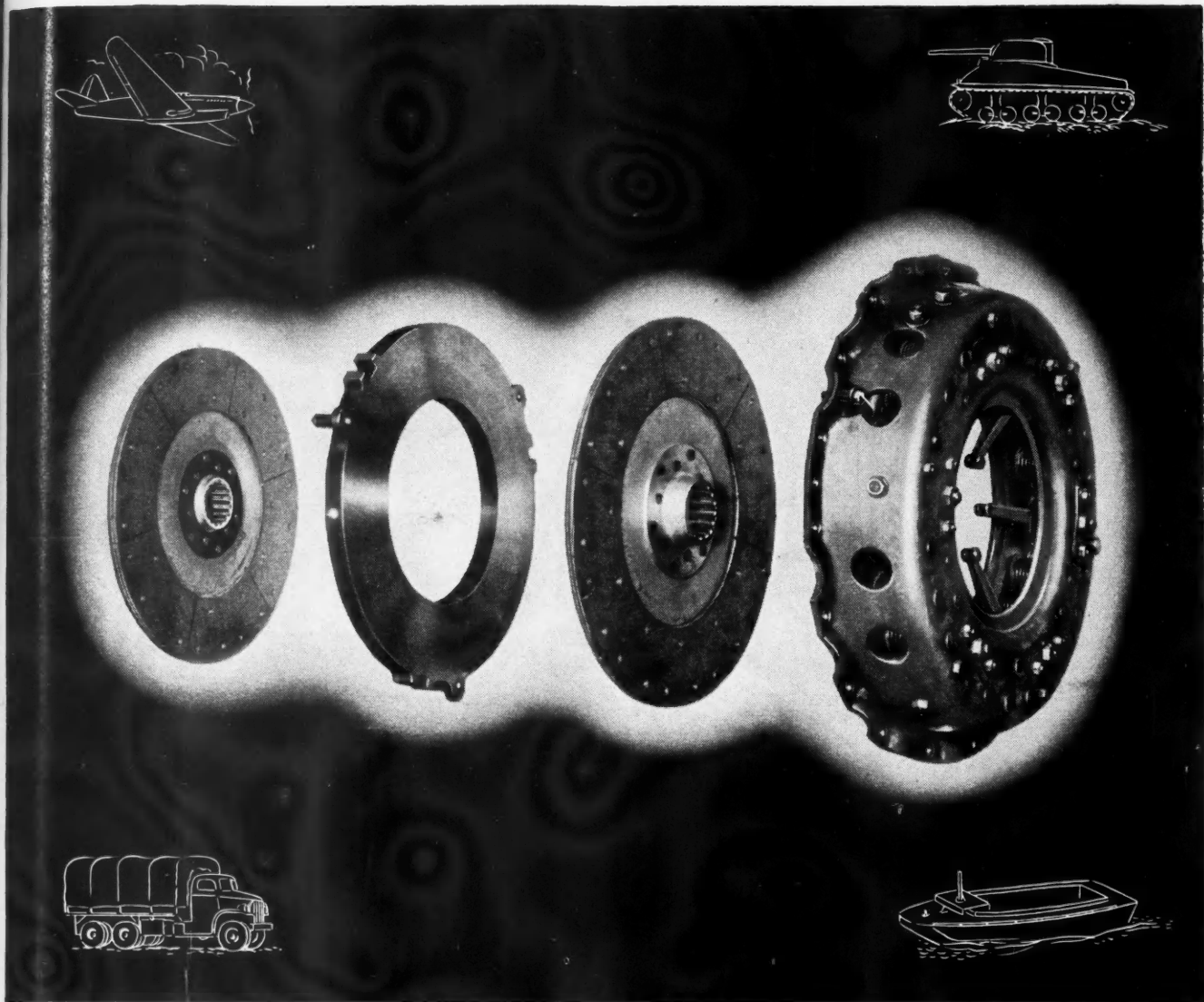
FOR AIRCRAFT ★ AUTOMOBILE ★ MARINE AND INDUSTRIAL ENGINES

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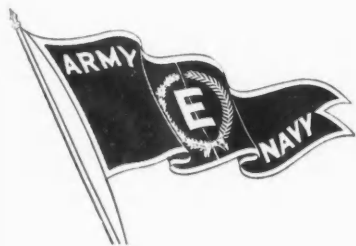
K O P P E R S

*Better by 25 Years of
Aviation Engineering
product*





ON PLANES AND TANKS AND TRUCKS AND SHIPS...LONG CLUTCHES



The implements of war require dependable clutches, too. Long builds them to serve on tanks, trucks, boats and planes, in many sizes and capacities, ranging from the biggest tanks to aircraft superchargers. Long radiators and oil coolers also serve the Allies on all fronts.

LONG MANUFACTURING DIVISION
BORG-WARNER CORPORATION
DETROIT • WINDSOR

LONG

CLUTCHES • RADIATORS • OIL COOLERS

Modern inspection by optical projection saves time and money

Jones & Lamson Comparators are available in Pedestal, Bench and other types to meet every need in the field of Inspection by Optical Projection. We shall be pleased to study your problems and apply to them the accumulated experience of more than twenty years in this field.



Profit-Producing Machine Tools

JONES & LAMSON MACHINE COMPANY

SPRINGFIELD, VERMONT, U. S. A.

Manufacturers of: Ram and Saddle Type Universal Turret Lathes -
Fay Automatic Lathes - Automatic Thread Grinders - Optical Comparators - Automatic Opening Threading Dies and Chasers.

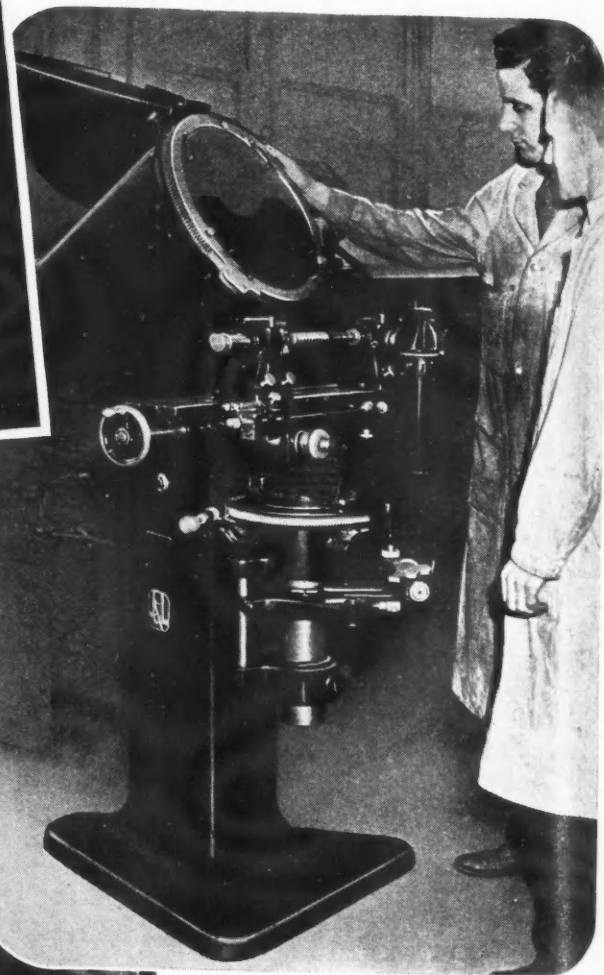
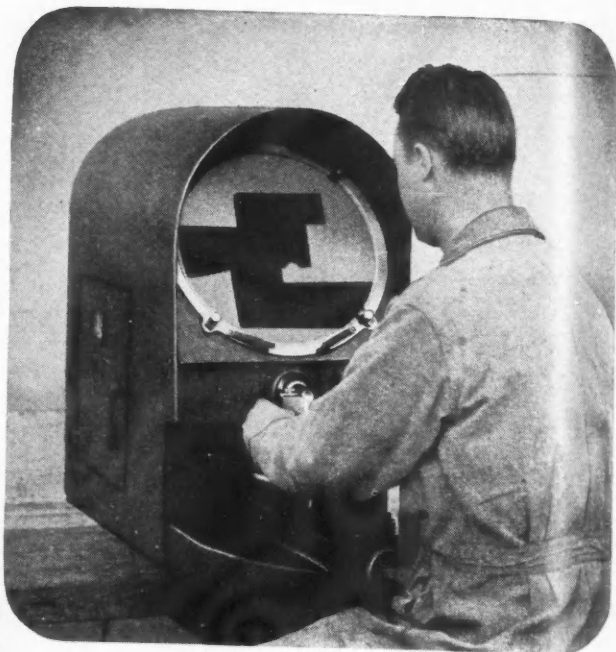


Photo Courtesy International Business Machines



DEATH LEAVES A FINGERPRINT

Probably it was hot and humid in the assembly room... that day when warm, perspiring fingers accidentally touched a tiny, needle-pointed shaft. But the fingerprint remained... acid, corrosive...

A saboteur—this accidental fingerprint? Yes—for on a later day that tiny part, weakened by corrosion, may fail—in a submarine depth-gauge, an airplane altimeter, or in any of scores of delicate military

instruments. And just because of a fingerprint, a man may die.

* * *

ANOTHER WAR JOB FOR AIR CONDITIONING. Where precision instruments are made, on which men's lives depend, air conditioning reduces perspiration... filters out dust... helps speed output.

And this is but one example of how General Electric air conditioning and industrial refrigeration may serve the

war effort. To meet the exacting requirements of these wartime applications, General Electric is producing equipment that is highly efficient... flexible... compact.

When peace comes, this improved air conditioning equipment — by General Electric—will be available to all.

General Electric Co., Air Conditioning and Commercial Refrigeration Dept., Division 436, Bloomfield, N. J.

Air Conditioning by
GENERAL  ELECTRIC

**FASTER . . .
EASIER . . . SAFER . . .
MORE
ECONOMICALLY . . .**



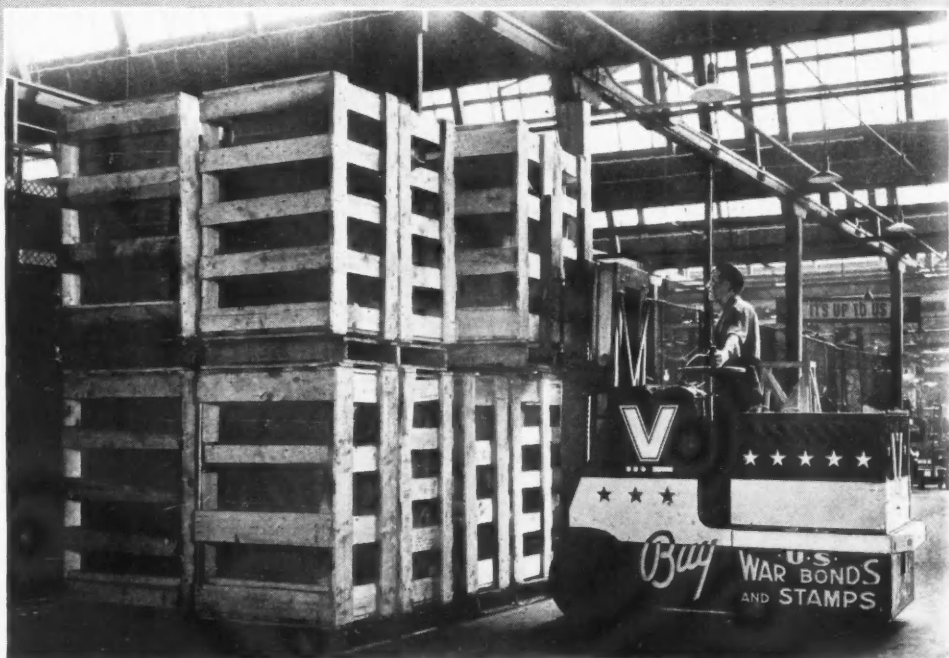
• It is easy to bring any material handling system to its highest efficiency in the movement and storage of materials by the simple means of adding 'AUTOMATICS.'

In many of America's plants that are producing for victory, 'AUTOMATICS' are aiding in getting much faster action and have eliminated wasteful handling and storage time.

With such top performance as a basis for figuring, it is well to consider 'AUTOMATICS' for the post war era when speed, safety, simplicity, and economy in materials handling will be as important as ever.

Let an 'AUTOMATIC' representative show you 'AUTOMATIC' ability and advantages.

★
'AUTOMATIC' representatives are listed in the classified telephone directories in principal cities and industrial areas under "TRUCKS," INDUSTRIAL.



MANUFACTURERS FOR OVER 35 YEARS *Electric Propelled* INDUSTRIAL TRUCKS

AUTOMATIC TRANSPORTATION CO.

DIV. OF THE YALE & TOWNE MFG. CO.

57

WEST 87th STREET

CHICAGO, ILLINOIS



IT'S THE NUT THAT LICKS FASTENING PROBLEMS

THINK of the tough jobs for nuts on planes, tanks, guns, naval vessels and production equipment.

And it's in these jobs you'll find Elastic Stop Nuts.

In fact, you'll find more of them than all other lock nuts combined.

The reason is, these nuts stay put.

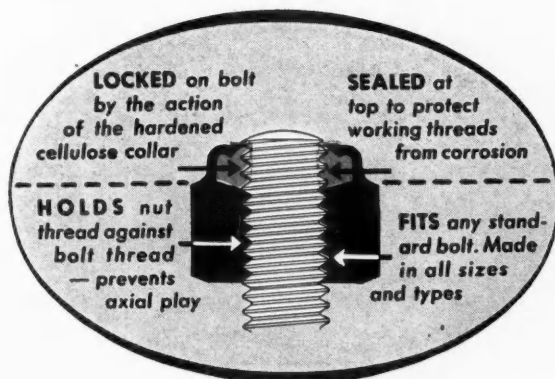
Once on, they're set — don't shake loose even under severe vibration. And you can take them off and put them on many times and they won't lose their locking ability.

When peace returns, they're going to solve all kinds of manufacturing problems. They're going to relieve maintenance engi-

neers of frequent inspections and *save time and money in replacements.*

Our engineers have been solving fastening problems for years — the stickers of both peace and war.

Whenever you have a fastening detail to be met, feel free to call upon us. We'll gladly share our experience and recommend the right Elastic Stop Nut.



ELASTIC STOP NUTS

Lock fast to make things last

ELASTIC STOP NUT CORPORATION OF AMERICA
UNION, NEW JERSEY

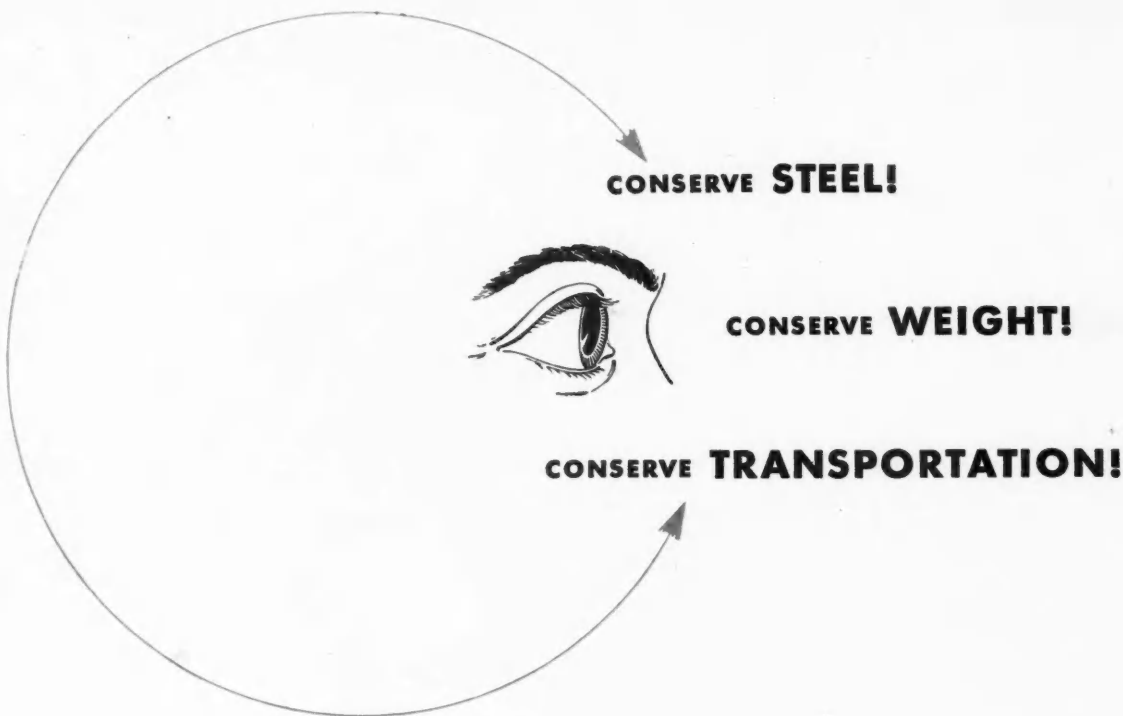




*I*n plants from coast to coast, Birdsboro general molding presses and multiple platen sheet presses are passing the toughest performance tests with ease. Operation under actual plant conditions testifies to the minimum maintenance and maximum production standards set by Birdsboro Plastic Presses. If yours is a press problem, it pays to ask Birdsboro.

BIRDSBORO STEEL FOUNDRY & MACHINE COMPANY • BIRDSBORO, PENNSYLVANIA

BIRDSBORO
HYDRAULIC PRESSES



MAKE YOUR PRODUCT OF

N-A-X

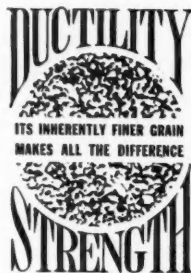
HIGH TENSILE

When you build your product of N-A-X HIGH TENSILE you conserve 3 ways—you conserve steel, you conserve weight, and you conserve transportation.

With N-A-X HIGH TENSILE, you need less steel to provide a given strength factor. That saves steel! You can build lighter without any sacrifice of strength. That saves weight! And when you save weight you save transportation—and that's a vitally important factor today in speeding our war effort.

N-A-X HIGH TENSILE is the answer to many a production problem today. Its high ultimate strength, high yield point, unusual ductility, easy weldability, and its unusually high resistance to impact and fatigue in sub zero cold or blistering heat—makes N-A-X HIGH TENSILE a superior steel for hundreds of exacting applications.

Why not investigate N-A-X HIGH TENSILE for your product? A Great Lakes Engineer will be glad to show you how this unusual steel can be used to advantage. Send for new booklet on N-A-X 9100 Series—and useful Hardenability Chart.



GREAT LAKES STEEL CORPORATION

Detroit, Michigan
Sales Offices in Principal Cities



Division of
NATIONAL STEEL CORPORATION
Executive Offices • Pittsburgh, Pa.

WHEN THAT EXTRA SURGE OF POWER IS NEEDED

DEPEND ON HALL-GROUND VALVES AND VALVE SEATS

Into the experience of every pilot there come times when his own safety, as well as that of crew and passengers, depends upon an extra surge of power.

That's the time he can be thankful for properly seating valves—for valves and valve seats ground to HALL standards of precision and finish.

HALL grinding of precision and maintenance of all types of aero engines (Axis excepted) that valve failure has been practically eliminated in both commercial and military flying.

For the duration our production facilities are devoted entirely to the winning of the war but our engineers will be glad to discuss your post-war plans with you NOW.

The Hall Manufacturing Co., Toledo, Ohio



1
Model AW Wet Type HALL ECCENTRIC Aviation Valve Seat Grinder. Made in both production and maintenance types. Other aviation types, portable and stationary, for every seat grinding need. Precision, finish, speed and operating ease and economy characterize all models.

2
Model 80-A wet type HALL Aviation Valve Refacer. Has dual motor, rheostat control of grinding speed, that will type collet valve stems and provides precision and finish to match HALL-ground valve seats.

2

War Service

Memo:

*To users of Southwark
Testing machines*

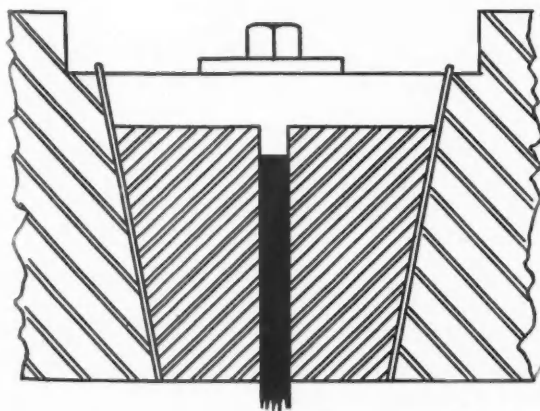
the proper use and care of

Grips

Here are a few suggestions that will enable you to extend the life of grips and eliminate one of the primary sources of trouble in physical testing.

Grips are especially designed for handling various shapes and types of specimens. Always use the proper grips for each specimen. Use "V"-grips for rounds and flat grips for flat specimens.

In selecting proper grips, the material to be tested must be considered. For example, round bars of soft steel or brass up to about $\frac{1}{2}$ -in. diameter can be safely tested with flat wedge grips, whereas, spring temper or hard drawn wire only $\frac{1}{8}$ -in. diameter would damage flat-face grips. For materials such as music wire, special grips with renewable file faces are recommended.



Remember that in the interest of strength and toughness, the ordinary wedge grip—either flat or "V"—cannot be made as hard as a file. Occasionally it may be necessary to make tests on materials harder than the grips. In this case an old set of grips should be used.

Before a specimen is pulled, the double pinion gears used for moving the grips in the slots should be centered and anchored in place with the set bolts. Otherwise the specimen will not be centered and may not be pulled straight.

Sufficient liners should be used, of the same thickness on both sides of each grip, so that the grips are well within the crosshead of the machine. If one or both grips pull through when the load is applied they may break or they will upset the corners of the crosshead casting and are likely to damage the double pinions.

Test specimens should extend at least $\frac{3}{4}$ of the length of the grips.

When grips do not move smoothly in the heads, as revealed by a clicking noise and a jump on the load indicator, a lubricant should be used on the back of the grips. Any grease used to lubricate lathe centers is satisfactory. White lead in oil is frequently used. Use only a small amount—and only on the backs—or it will collect scale and dirt.

Always use grips retainer furnished for bolting to crosshead castings, otherwise recoil may throw the grips out of the machine.



BALDWIN SOUTHWARK

Division THE BALDWIN LOCOMOTIVE WORKS, Philadelphia, Pa.



BUY
U. S. WAR
BONDS

**What we are making today is
Uncle Sam's business . . . what we make
tomorrow will be *your* business!**

HOUDAILLE's many factories, strategically located throughout the country, are steaming full-blast to hasten the day of victory.

There is scarcely a piece of automotive equipment—jeep, truck, tank or plane—on any American fighting front, that isn't doing just a little better job, because of Houdaille* quality equipment.

Our engineers, metallurgists and precision mass production experts, out of this war experi-

ence, are evolving revolutionary technological advancements, of far-reaching interest to industry and to the nation.

We look forward eagerly to a new automotive era, to the new day of universal flight, which has already dawned, and to the greater convenience and comfort of the American home—due, in part, to Houdaille contributions.

A new world is in the making . . . and Houdaille is *helping to design it.*

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HOUDAILLE-HERSHEY CORPORATION

General Executive Offices, Detroit, Michigan

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HOUDAILLE'S PEACETIME PRODUCTS: Houdaille Hydraulic Shock Absorbers for Automotive, Railway and Industrial Equipment ★ Bumpers and Grille Guards ★ Ignition Locks ★ Brake Levers ★ Air Cleaners ★ Crankshafts and Camshafts for Aircraft, Automotive and Marine Engines ★ Aircraft Landing Struts and Shimmy Dampers ★ and many other precision-made parts for the Automotive, Aircraft, Electrical Refrigeration, Radio and other industries.

BRAKE DRUMS

to meet your
SPECIFICATIONS



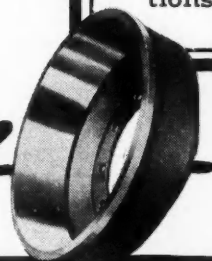
USERS of your trucks and tractors demand Brake Drums made to stand hard usage, especially those used on war equipment. Today Brillion Brake Drums are in use on thousands of trucks and fighting equipment—all of them made especially to meet the Manufacturers' specifications. Not one is a stock item, because with us Brake Drums are manufactured to meet a specific need. And, with us Brake Drums are a major item—necessary to the war effort—not a side line. *We are Brake Drum specialists.*

Brillion Brake Drums are *cast iron*, the finest that foundry skill and experience can produce. Your specifications will be given careful attention from the layout of the job to the finished product.

We'll Build Brake Drums to Meet Your Specifications

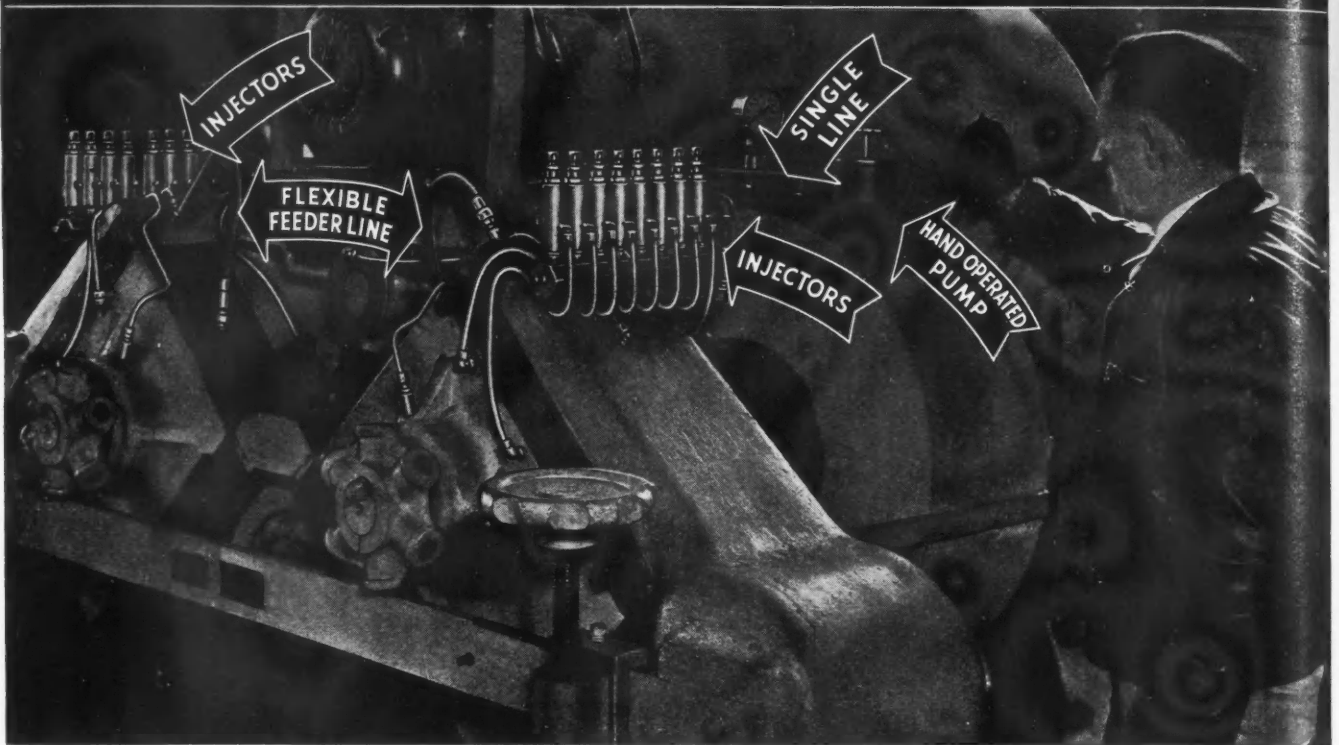
We can furnish drums in large quantities according to your requirements. And, you are assured of expert workmanship when you specify Brillion Brake Drums. Illustrated above is a brake drum made to specifications for one of the large manufacturers—representative of the type we manufacture. Send your specifications to us for quotations.

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BRILLION, WISCONSIN

NO MANPOWER PROBLEM here!



War Production Can Be Kept Going At Top Speed!

... Now instead of requiring a long shut-down, a machine can be kept running, and *all* bearings lubricated with a few strokes of the pump ...

It's possible when the machine has been equipped with a

LINCOLN

CENTRO-MATIC LUBRICATING SYSTEM

It doesn't take a large force of service men to lubricate machines equipped with Lincoln Centro-Matic Lubricating Systems ... Under this modern method one man can do the whole job in a fraction of the time it would take several men to contact each individual bearing.

Illustration above shows a Lincoln Centro-Matic System installed on an angle shear.

A Centro-Matic System consists of a number of Centro-Matic Injectors—one for each bearing—and a power operated or a hand operated Centro-Matic Lubricant Pump. A power operated system can be

either time clock control or push button control ... The injectors can be grouped in manifold or located separately at each bearing. In either arrangement only a single lubricant supply line is required ... Easily installed on new or old machines.



ARMY-NAVY PRODUCTION AWARD for high achievement in the production of war equipment has been conferred upon the Lincoln Engineering Company. It serves as inspiration toward greater and greater accomplishment until the time of final and complete Victory.

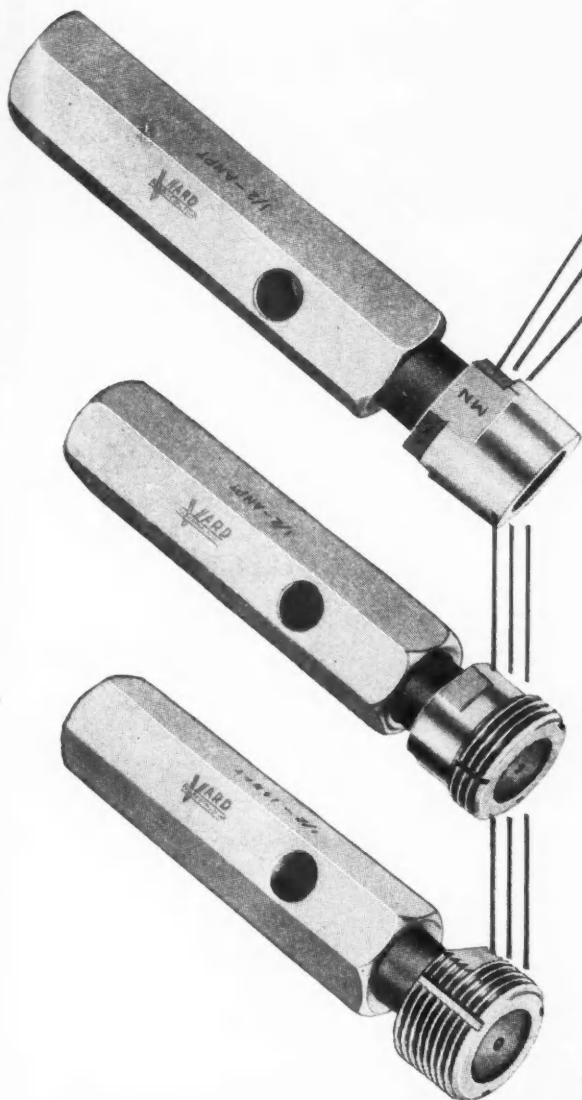
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LINCOLN ENGINEERING COMPANY

Pioneer Builders of Engineered Lubricating Equipment

ST. LOUIS, MO., U. S. A.



with VARD precision Plug Gages

If you are manufacturing or are assembling units in which there are pipe connections threaded to the Army-Navy Specification, AN-GGG-P-363, you will need accurate pipe plug gages.

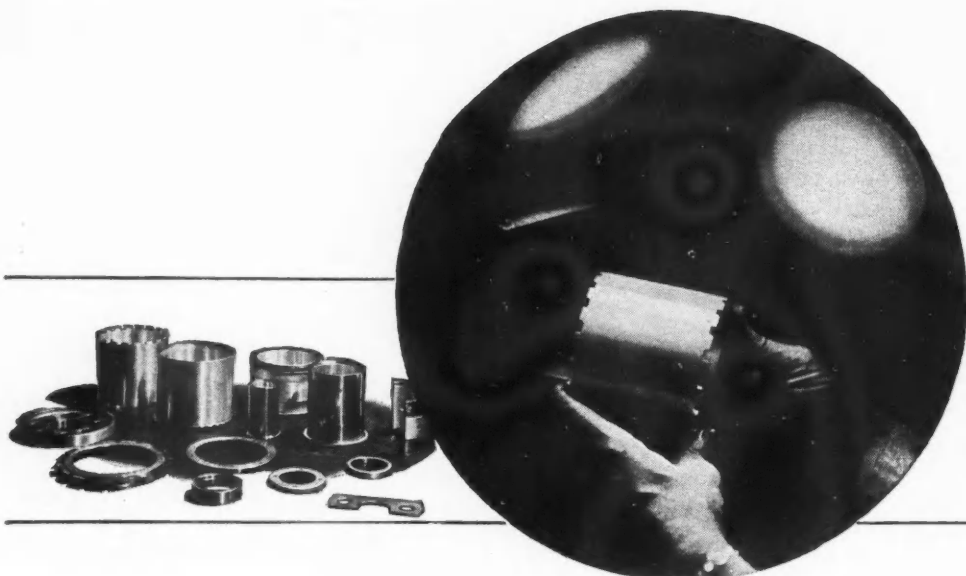
These VARD Pipe Plug Gages will quickly check the Major and Minor Diameter of internal threads, the thread form and truncation as well as lead and minimum length of threading.

VARD Pipe Plug Gages are made to American Gage Design standards and the Army-Navy Specification. They may be obtained in a full range of sizes 1/16th-inch to 6-inches diameter. All VARD Pipe Gages are made of selected tool steel, hardened, ground and finished to the specified tolerances.



VARD INC.

PASADENA, CALIFORNIA, U. S. A.



"Black Light" testing makes certain the bond is perfect on edges of all Mallory Bearings. Under its magic rays, microscopic voids and cracks show up by fluorescence. A filter cuts out visible radiation from the "Black Light", allowing only ultra-violet radiation to pass.

MALLORY Bearings

Meet Critical Loads Superbly

WHERE ordinary bearing surfaces are inadequate to meet the stresses and strains a fighter plane's engine must undergo, Mallory Bearings function marvelously. They can take the terrific pounding and fatigue stresses imposed by suddenly applied loads from a high powered pursuit plane in action.

Mallory Bearings are made by Mallory's Mallosil Process of bonding silver to base metal backings. They provide a tough, homogeneous, heat dissipating silver surface of high fatigue resistance; ample strength and hardness; and high resistance to seizure.

What is more, Mallory Bearings are precision made. Through use of newly designed precision tools and test instruments, skilled Mallory craftsmen have set remarkable records for exactness and uniformity in producing bearings, bushings, pinion races, gear races and other aircraft engine parts. With tolerances measured in split-thousandths, they are turning out ever-increasing quantities of precision parts with an accuracy and uniformity considered impossible only a few short months ago.

Continuous experimental designing and testing indicate even greater results for the future. The experience and technique gained in War production will be invaluable for commercial motors development when Peace has arrived. Consult us on the possibilities of the Mallosil Process for you.

P. R. MALLORY & CO., Inc., INDIANAPOLIS, INDIANA • Cable Address — PELMALLO



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MALLORY

SERVES THE AVIATION, THE AVIATION-INSTRUMENT AND THE AVIATION-COMMUNICATION FIELD WITH WELDING TIPS, THE MALLOSIL PROCESS—BEARINGS, SPECIAL ALLOYS, ELECTRICAL CONTACTS, VIBRATORS, VIBRAPACKS, CONDENSERS, ROTARY AND PUSH BUTTON SWITCHES, ELECTRONIC EQUIPMENT, COMMUNICATIONS HARDWARE, RECTOSTARTERS

2 Net Gains



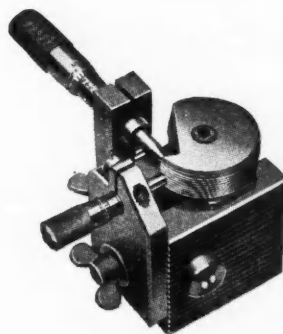
There, in three words, is the essence of modern manufacturing.

For tapping operations on 3" to 5" work, wherever extreme accuracy is required, Namco Collapsible Taps are setting new production standards.

← RSP COLLAPSIBLE CIRCULAR CHASER TAPS

... are applicable on both stationary and rotating spindle machines. They maintain accuracy over long runs, on tough alloys and stringy stock, and on close-to-shoulder work.

Circular Chasers are ground on blocks. In many plants a duplicate set is kept ready. When chasers become dull, the duplicate set is inserted in the head—to cut identical threads—without readjustment. Production is resumed in two minutes, without spoilage of costly parts.



NAMCO MICROMETER GAUGE

... determines correct amount of Circular Chaser grind, and checks precision after grinding. Chasers may be ground through 270° of circumference—they last 10 to 30 times longer.

THE NATIONAL ACME CO.

170 EAST 131ST STREET • CLEVELAND, OHIO

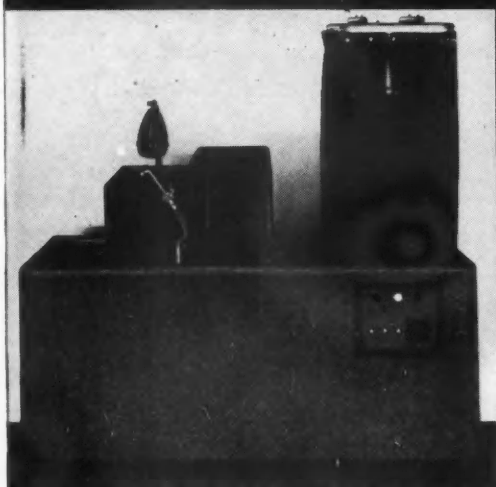
ACME-GRIDLEY 4-6 AND 8 SPINDLE BAR AND CHUCKING AUTOMATICS • SINGLE SPINDLE AUTOMATICS • AUTOMATIC THREADING DIES AND TAPS • SCREW MACHINE PRODUCTS • THE CHRONOLOG • LIMIT SWITCHES • POSITIVE CENTRIFUGE • CONTRACT MANUFACTURING

OUT OF THE DARKNESS COMES

Zyglo

(REG. U. S. PAT. OFF.)

TO PUT THE FINGER ON FAILURE



Complete Zyglo Inspection Station ZA-2D for small volume or laboratory.

The New Inspection Method Now Ready To Speed Your Output of Perfect Parts

(Non-Magnetic as well as Magnetic)

● Zyglo Black-Light Inspection now takes its place beside the original Magnaflux Method as Industry's means of predicting areas of probable failure in non-magnetic parts. Announced some months ago, Zyglo has been put on a production-line basis in selected plants where it was needed most under war conditions. Aluminum castings (and other light metal parts) for the warplane program have had the finger of Zyglo indications put on them before assembly—before they carry a defect into finished products—long before the possibility of failure in battle. Another factor in the supremacy of American arms!

In the illustration, here, of aluminum castings—dipped in a penetrant fluorescent liquid, then rinsed, dried, powdered and observed under black light—serious shrinkage cracks were shown up. The glowing fluorescent indications signal the exact locations in which the penetrant remained during rinsing, then developed finally on the surface under capillary action by the powder.

Zyglo, with its laboratory years behind it, has met the test of the production line with thoroughly practical results: *Clear, easily interpreted indications. Routine handling without delaying the flow of work. Big direct savings of labor, wasted when defective parts are assembled. Enormous indirect savings through prevention of failures.*

To fit Zyglo into the routine of factory or overhaul shops a line of equipment has been developed. A complete compact unit is shown here. All other units give larger capacity. Not only the practical equipment is available to licensed Zyglo users, but the full Magnaflux Service. This amounts to a continuing consulting and engineering service on flaw detection.

A great percentage of American manufacturing will find applications for Zyglo in the competition of the final war and early postwar years. You are urged to contact the Magnaflux Corporation to determine definitely the advantage of Zyglo in your plant. Write, requesting the new Zyglo Bulletin.



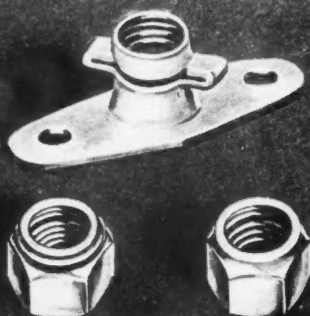
MAGNAFLUX CORPORATION

NEW YORK

5904 Northwest Highway, Chicago
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When the War is Over . . .

Boots Self-Locking Nuts will have even more widespread usefulness. Today, they are used in a variety of applications, including all types of AIRCRAFT, AUTO HEADLIGHTS, RADIO CONDENSERS, etc. Tomorrow, they will lengthen the life of your AUTOMOBILE, BICYCLE, WASHING MACHINE, VACUUM CLEANER, ELECTRIC REFRIGERATOR, and many other household appliances, as well as industrial, farm, and office machinery. Boots Nuts provide positive protection of permanent fastening wherever vibration, corrosion, or temperature are factors.

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Boots all-metal, self-locking nuts are lighter than ordinary nuts. Their use on heavy bombers saves more than sixty pounds of precious weight—a saving which can be turned into sixty pounds of fire-power, or about 200 rounds of .50 calibre machine gun ammunition. And those 200 rounds may easily mean the difference between "all our aircraft returned safely" and "one of our aircraft is missing."

All types of U. S. planes are protected with Boots Nuts. Not only are these nuts lighter, but they literally "outlast the plane." Furthermore Boots Nuts cut repair and maintenance time and have great reusability. They meet the exacting requirements of all government agencies.

"They Fly With Their Boots On — Lighter!"

BOOTS

Self-Locking Nuts For Application In All Industries

BOOTS AIRCRAFT NUT CORPORATION ★ GENERAL OFFICES, NEW CANAAN, CONNECTICUT

June 15, 1943

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The movement of only two conveniently located levers puts the full automatic machining cycle in operation.

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ENGINE

TOOL ROOM

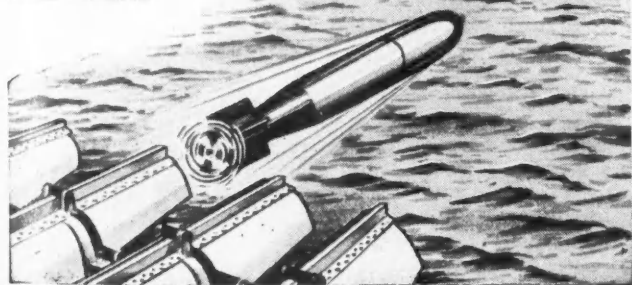
AUTOMATIC LATHES

FINE DISSTON STEELS

OF ORDNANCE QUALITY



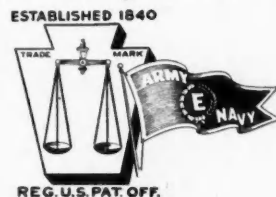
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ASSISTANCE FROM DISSTON METALLURGISTS AND ENGINEERS is available without obligation. Write fully about your problem to Henry Disston & Sons, Inc., 631 Tacony, Philadelphia, Penna., U. S. A.



STERLING 1000

New Electric Portable Sander



**FASTER!
SMOOTHER!
BETTER!**

SWIFT AND SMOOTH!

Get the job done quicker—and better with the new "Sterling 1000"! Powerful... rapid cutting—yet, because of skillfully engineered counter-balanced mechanism it operates *without a trace of vibration!* So smoothly does the "Sterling 1000" handle—that women operators prefer to work with this new sander. Elimination of operator's jingle-jangle nerves alone means higher quality work! And this sander is *tough*—sturdily built to serve you dependably... even under heavy production pressure.

DESIGNED ON NEW SANDING ACTION PRINCIPLE!

Orbital, circular, thousands of abrasive grains cut furrows which cross and recross each other. With this action, the "Sterling 1000" cuts faster—produces the smoothest surface you've ever known on wood, metal, plastic or composition. Ideal for many rubbing and polishing operations.

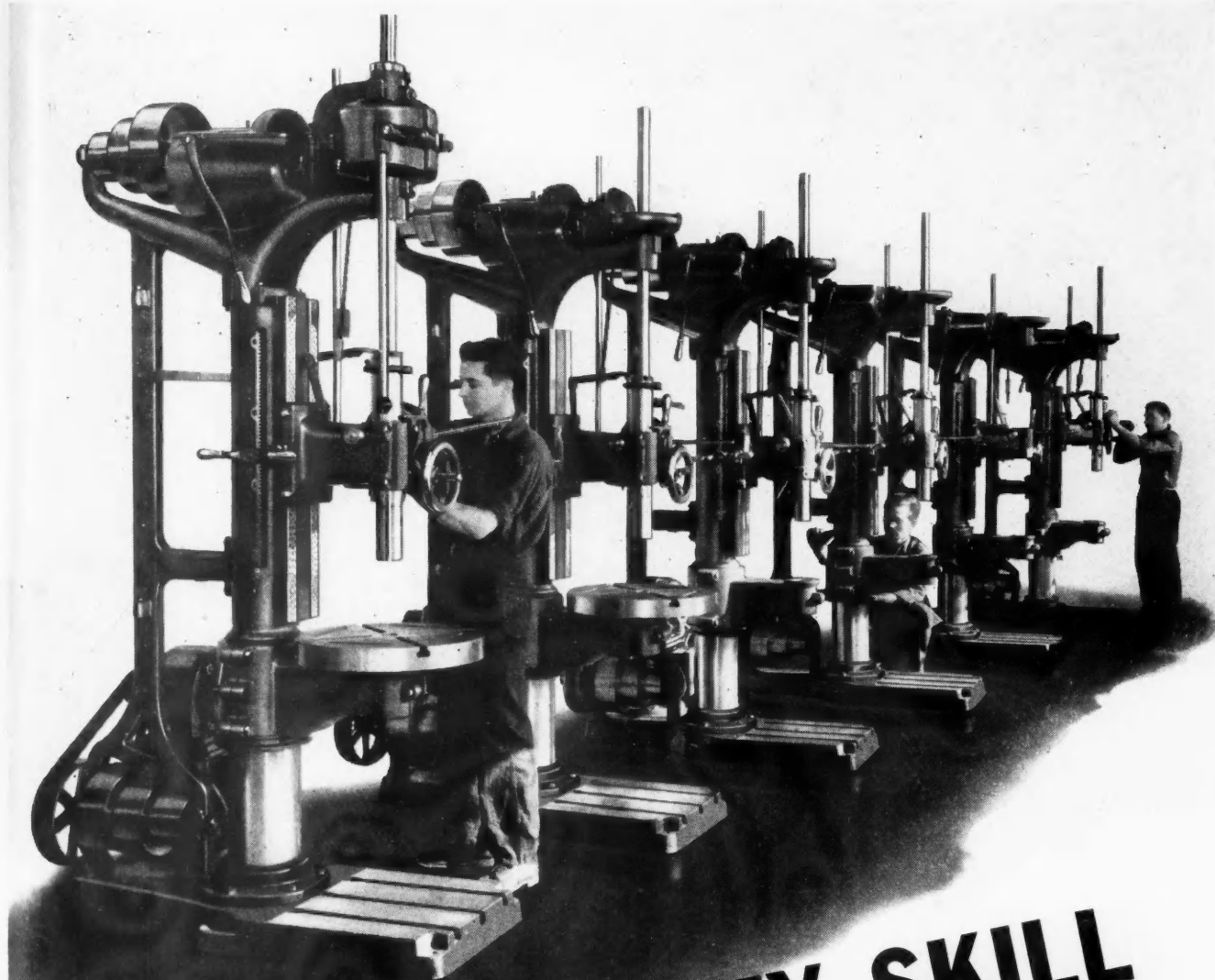
Write today for your copy of the New "Sterling 1000" folder, which describes its 21 important features in every detail.

STERLING TOOL PRODUCTS COMPANY

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RELY ON SIBLEY SKILL

**for Special Machinery
as well as Drill Presses**

You can depend upon Sibley for the necessary "know how" to produce the type of special machinery you need to meet your requirements.

Long experience in both drilling and special machinery manufacture for America's leading companies enables the Sibley staff to meet exacting specifications of any tough job you may have.

Available facilities permit Sibley to offer this specialized service now to a limited num-

ber of new customers. Here may be the answer to your present war production problems and peace-time plans.

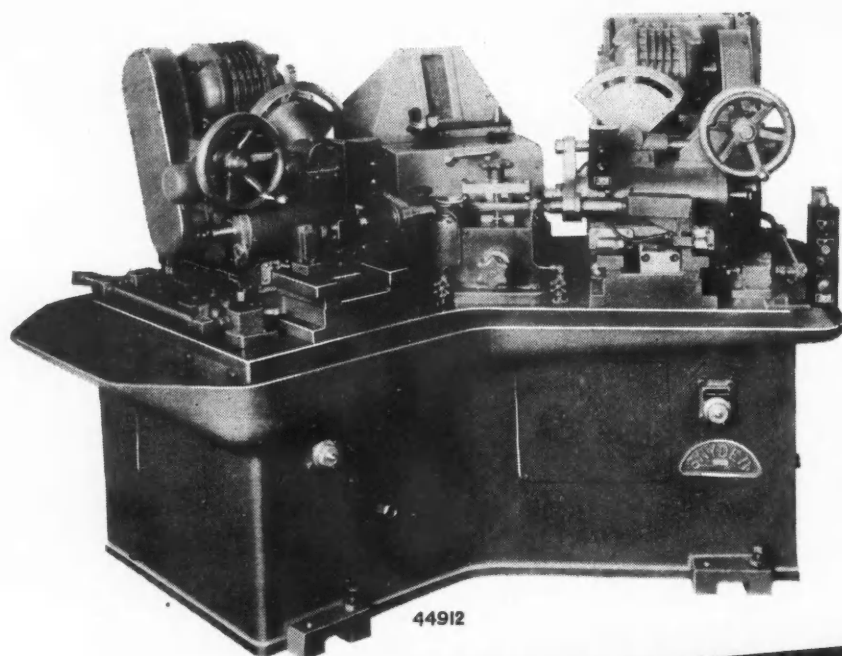
SKILL COUNTS IN SPECIAL MACHINING WORK

Sibley's ability to manufacture to close tolerances has been the answer to many production problems confronting leading manufacturers. If you need help on regular or special machine work, write, wire or phone.

SIBLEY

MACHINE & FOUNDRY CORP.
50 EAST TUTT ST., SOUTH BEND, IND.

DRILLING MACHINE MANUFACTURERS SINCE 1876



Accurately Weighing and Balance-Milling Connecting Rods by Semi-Automatic Cycle

Many of the familiar problems in weighing and balance-milling connecting rods for internal combustion engines are eliminated by means of special features in this new Snyder semi-automatic machine.

For the purpose of this operation, a small amount of excess stock is left on each end of the forging, the exact amount on each end being shown when the part is weighed on the double dial shadowgraph scale.

The piece is then clamped in the fixture and the operator locates the excess stock on the piece by advancing a finder which flashes on a green light to indicate correct contact. This adjustment automatically brings the cutting tool into exact alignment with the tip of the finder.

An excess adjustment of as little as .002" flashes on a red warning light which remains on until the setting is corrected.

The operator then sets the pointer on the

fan-shaped dial (above the milling unit) at the amount of excess stock which the scale indicated must be removed. This automatically sets the cutter in position to remove that amount of stock.

When these settings are made for each end of the connecting rod, an electric push button is pressed and both units feed cutters past the work, bringing it to correct balanced weight within the usual quarter-ounce limit.

Although the machine shown is designed with fixed center distances for a specific connecting rod, it is practical to build this machine with simple adjustments to handle two or more rods of various weights and sizes.

It is notable that no delicate dial indicators are used in locating excess stock, the finder being of hardened tool steel, ruggedly built and housed and the use of colored tell-tale lights to indicate accuracy greatly facilitates the entire operation.

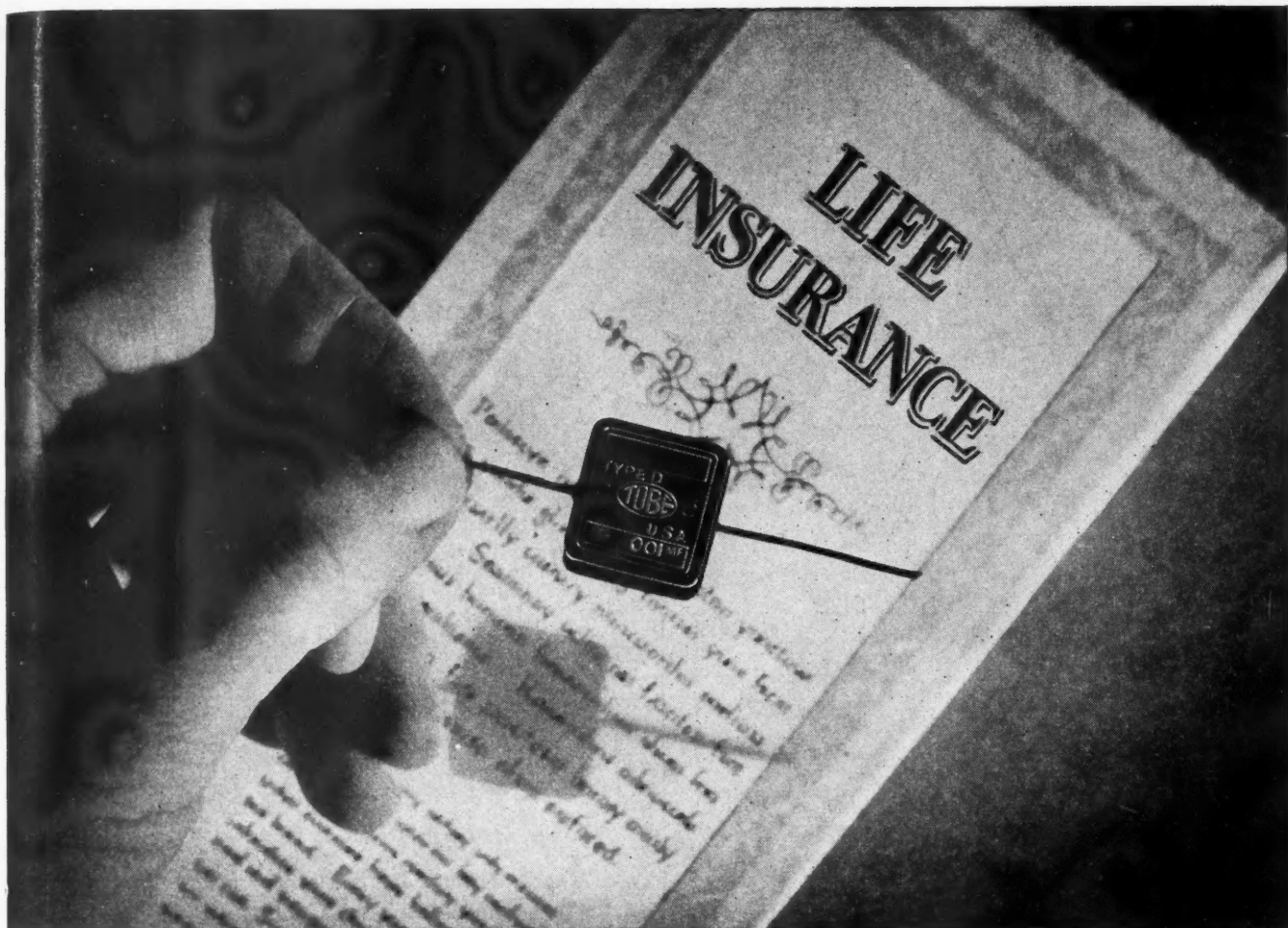
Perhaps you have a production problem that can be simplified by Snyder engineering. We invite your inquiries.

SNYDER

TOOL & ENGINEERING CO.

3400 E. Lafayette Ave. • Detroit

*designers and builders of machinery
for HIGH production at LOW unit cost*



NOW AVAILABLE FOR YOUR PRODUCTION REQUIREMENTS!

The first oil-impregnated condenser to be found physically and electrically interchangeable with the majority of mica capacitors used in the by-pass and coupling circuits of radio and radar equipment.

The Tobe Type DP Molded Paper Capacitor has *long life built into it* through every step of manufacture. Rigid inspections maintain a standard that is exceptionally

high—so high, in fact, that “returns” are almost completely unknown.

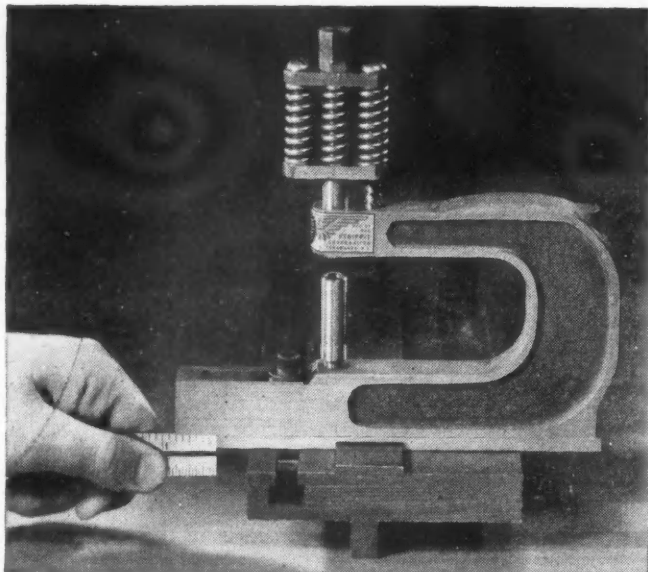
For the first time since its introduction we are *now* in a position to accept immediate orders for Type DP, with *prompt delivery assured*. They will be filled in order of receipt and we suggest you act promptly. For production samples or further information write TOBE DEUTSCHMANN CORP., CANTON, MASS.

SPECIFICATIONS—TYPE DP CAPACITOR

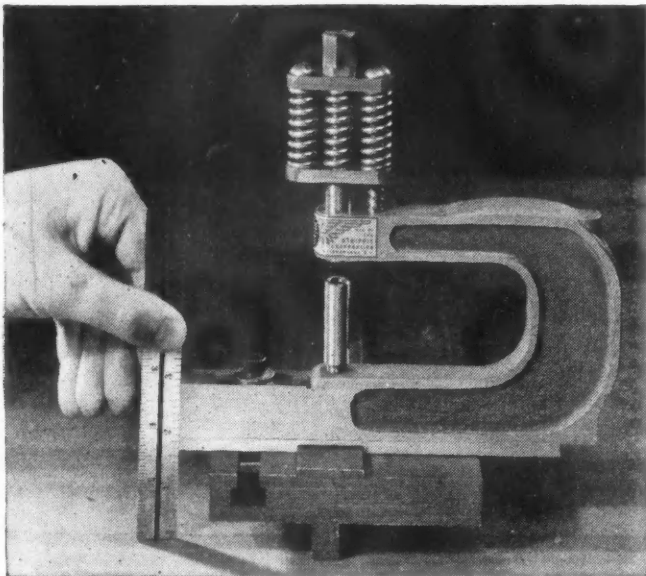
CAPACITANCE001 to .01 mfd.
WORKING VOLTAGE	600 volts DC—flash test 1800 volts DC
SHUNT RESISTANCE	At 185° F.—1000 megohms or greater
	At 72° F.—50000 megohms or greater
WORKING TEMPERATURE RANGE	Minus 50° F. to plus 185° F.
OPERATING FREQUENCY RANGE	Upper limit 40 megacycles
	Q at one megacycle—25 or better
POWER FACTOR	At 1000 cycles—.005 to .006

These capacitors meet Army and Navy requirements for immersion seal.



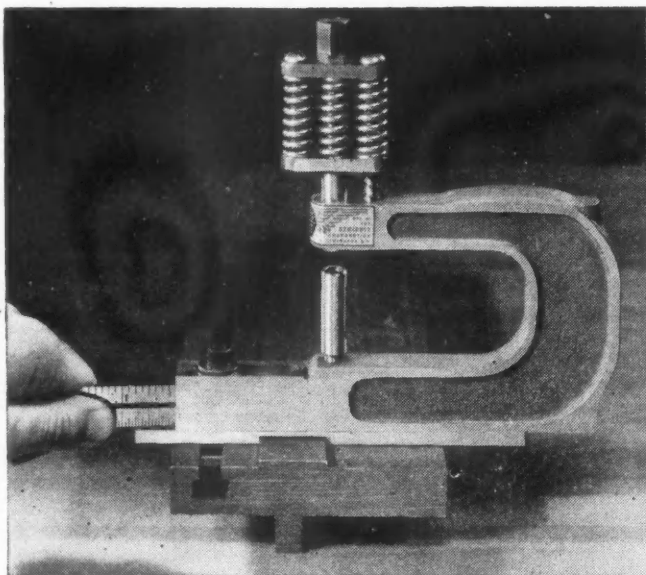


Above: Wales Type "CA" Hole Punching Unit moved maximum distance forward on built-in adjustable adapter.



Above: Showing unit centered by lining up front of holder flush with adapter plate.

Below: Unit moved maximum distance back. Note simplicity of locating by measuring with scale.



Announcing the **NEW** **WALES** Type "CA" HOLE PUNCHING UNITS with Adjustable Front to Back Adapters FOR STAGGERED HOLES

5 NEW FEATURES

1. May be located on standard rails between present units wherever required.
2. Die height and shut height same as Type "C" Units.
3. Standard punches, dies and stripping guides are used.
4. $\frac{3}{4}$ " adjustment front or back of center line.
5. Special adapters made to suit any requirement.

*"There's Always Something New in the Wales Line."
Write for Catalog CA.*

WALES-STRIPPIT CORP.

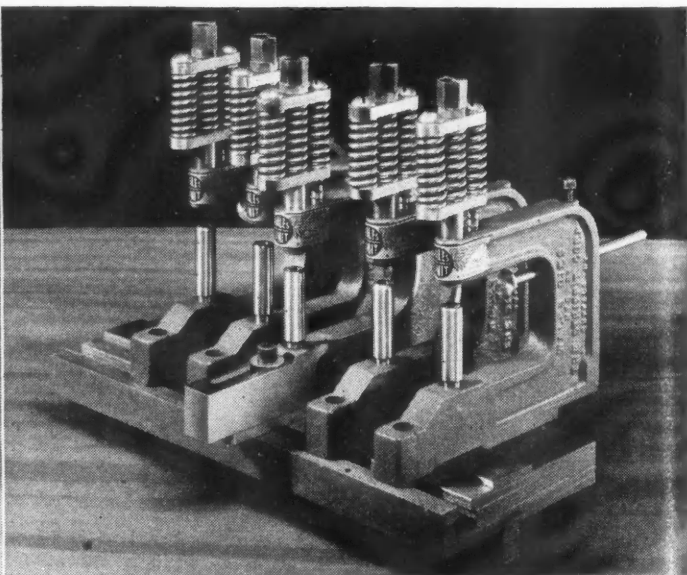
(Formerly The Strippit Corporation)

NORTH TONAWANDA, N. Y.

George F. Wales, President

Specialists in Punching and Notching Equipment.

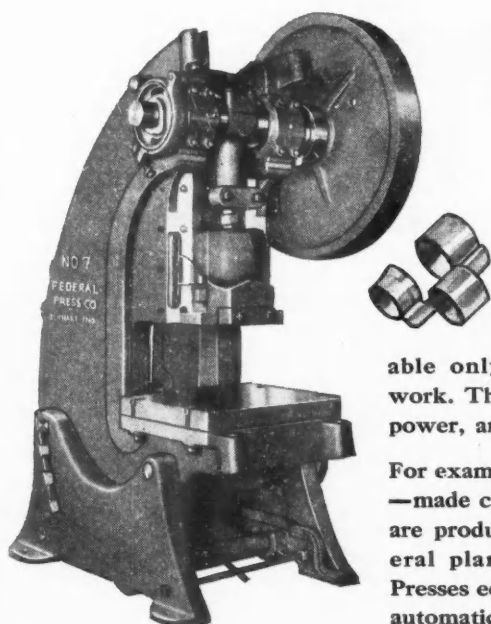
Below: Showing Wales Type "CA" and "C" Hole Punching Units in set-up on press brake rail. Center unit (Type "CA") with built-in adjustable adapter punches holes forward or backward of the straight line pattern produced by the other four Types "C" Units.





FOR SPECIALIZED WAR JOBS

STANDARD **FEDERAL** PRESSES SAVE TIME — MANPOWER — EXPENSE



9 FEDERAL SIZES

Federal Open-Back, Inclined Presses are available in nine sizes, with capacities ranging from six to 80 tons—either flywheel or geared type. They are the products of 40 years' experience in press building.

Standard Federal Presses are now producing scores of war items which formerly would have required special machinery with limited utility, suitable only for highly specialized work. They are saving time, manpower, and reducing costs as well.

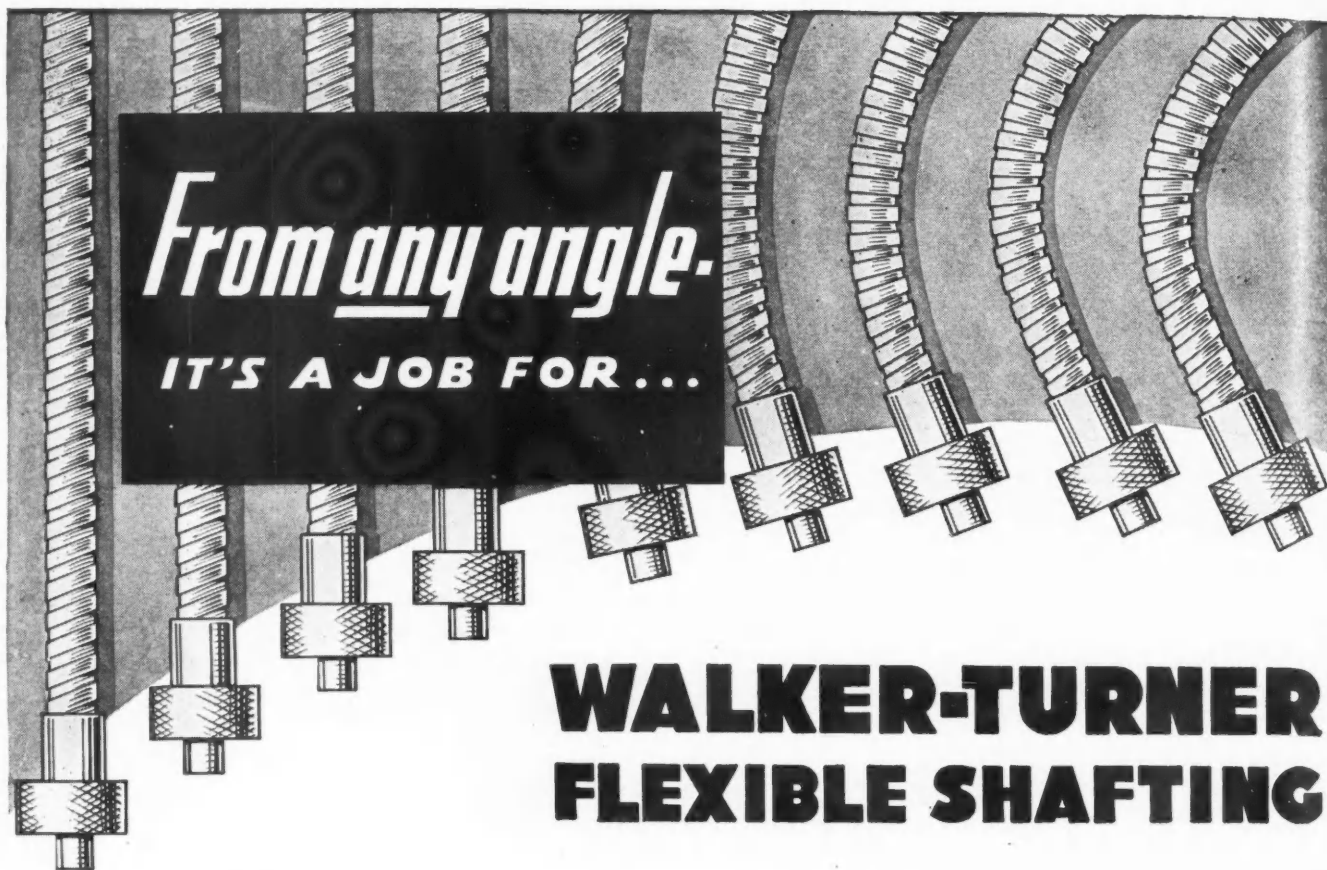
For example, machine gun belt links—made complete from strip stock—are produced at high speed in several plants on standard Federal Presses equipped with roll feeds and automatic stops. This sensitive stop was developed by Federal to give intricate dies protection in case stock is fed improperly. Operating off the crankshaft by a cam, this automatic feature stops the press at the top of a stroke whenever the work is not in exact position. Stand-

ard Federal Presses can be quickly adapted to many specialized jobs and are now serving their owners in a variety of unusual ways to help win the war.

If you have any jobs requiring specialized press work, get the facts from Federal. Write today for latest literature, or for help in working out a specific problem.

FEDERAL OPEN-BACK—INCLINABLE **PRESSES**

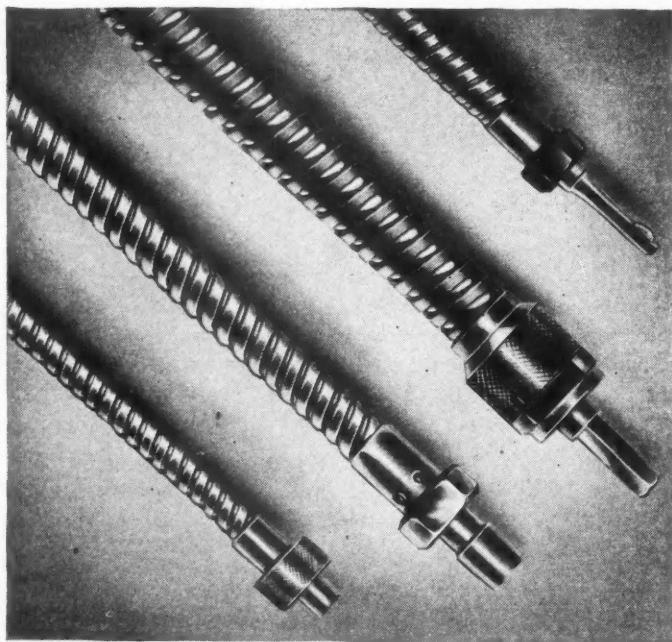
THE FEDERAL PRESS CO.
906 Division Street, Elkhart, Indiana



From any angle.

IT'S A JOB FOR...

WALKER-TURNER FLEXIBLE SHAFTING



Is your problem the transmission of a small amount of power at an angle, or between two points not in a straight line? Or is it the matter of control of some mechanical or electrical impulse from a point relatively remote?

In either case, the chances are that Walker-Turner Flexible Shafting can do the job more effectively than any other means. For many years Walker-Turner has manufactured flexible shaft machines, which are today used by the thousands throughout industry. The specialized knowledge of the design of flexible shafting which we have gained in this work, has been applied to many war applications of power transmission and remote control, under the most exacting conditions.

We offer this experience for the assistance of those designing engineers who have problems involving the use of Flexible Shafting.

WALKER-TURNER COMPANY, INC. • 4663 Berckman St., Plainfield, N. J.



FLEXIBLE SHAFTING

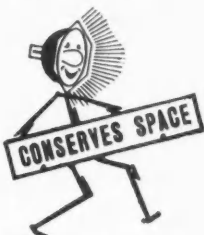
FOR REMOTE CONTROL AND POWER TRANSMISSION



Reducing processing time from hours to minutes means increased production and lower unit cost.



Processing all pieces under identical conditions means uniform results with a minimum of rejects.



Requiring less floor space means more production per square foot.



Efficient utilization of power means low energy cost per piece.



Reducing overall time for processing means less labor, less handling, and fewer manhours.

Manpower Saved

MORE PRODUCTION-QUICKER

Baking-Drying-Dehydrating or Preheating



FOR EXAMPLE—A prominent switch manufacturer discovered that the Near Infrared Process permits one worker to paint, bake and pack as many switch boxes as formerly produced by 4 workers with a previous method. The amazing speed, utility and savings of Infrared has been applied to hundreds of varying operations. Case studies applicable to your production are available on request.

Manpower and man-hours — a vital problem today — are being greatly conserved by the Near Infrared Process. This amazingly fast method of heat transfer cuts processing time in many cases from hours to minutes for baking, drying, dehydrating and preheating — reduces many product handling operations — requires no skilled labor — cuts manpower and man-hour needs substantially.

The utilization of Fostoria Near Infrared equipment is low in both initial investment and operating cost. It is quickly and easily installed and can be moved readily. High flexibility provides adjustment to accommodate varying uses and shapes and sizes of products.

Throughout war industry, today, the rapid employment of the Near Infrared Process proves its remarkable advantages. It offers a probable solution to your particular production problem.

THE FOSTORIA PRESSED STEEL CORPORATION, FOSTORIA, OHIO

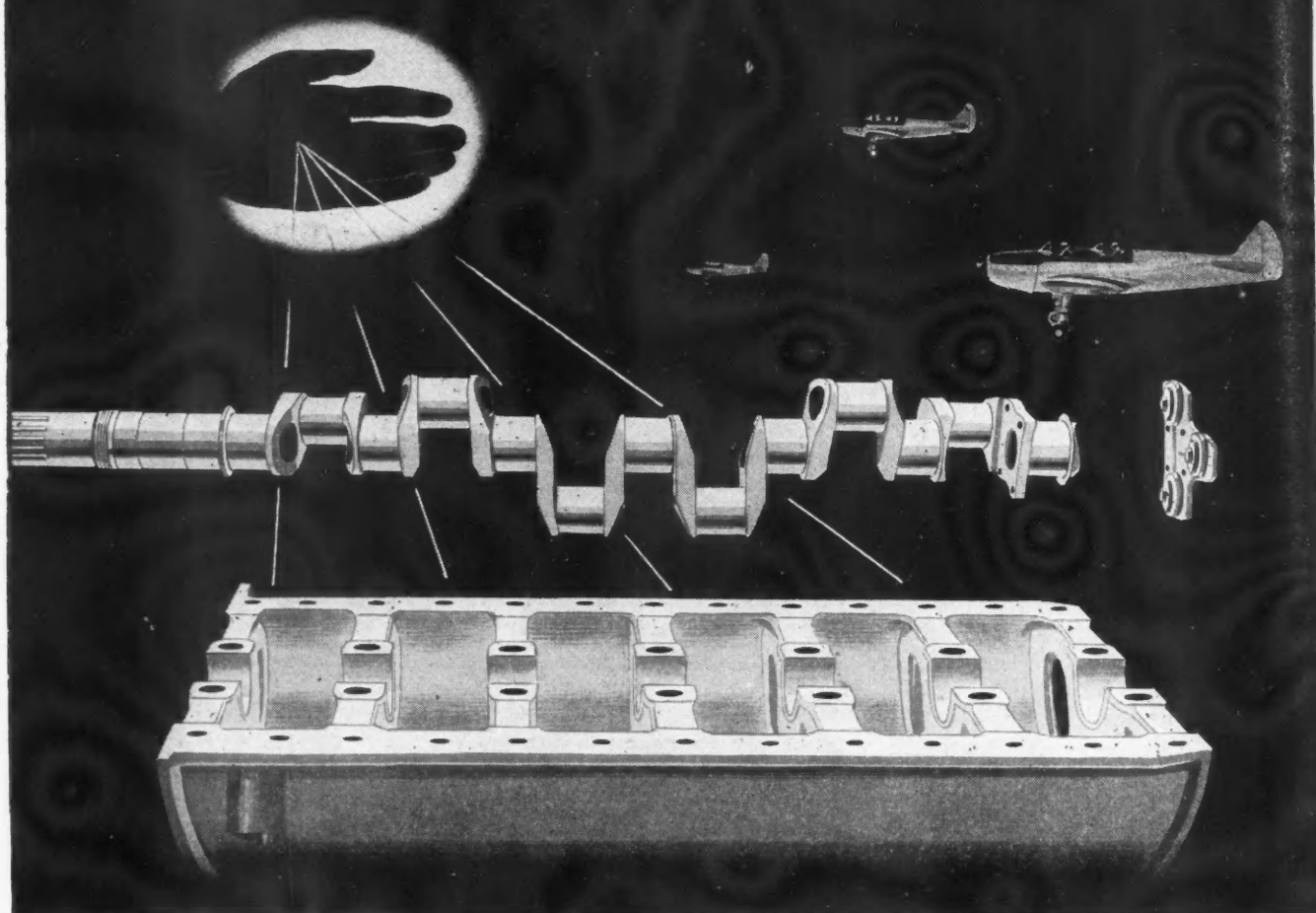
In Canada — Write Amalgamated Electric Corp., Ltd., Toronto

Call Your Fostoria Industrial Service Center FOR PRETESTING AND RECOMMENDATIONS

Fostoria Industrial Service Centers, located in principal cities, are properly equipped and well qualified to solve your baking, drying, dehydrating or preheating problem. If their practical tests prove the Near Infrared Process to be a logical solution, the proper equipment to do the job is recommended. The service provides installation supervision and stands by to help the user obtain and maintain forecasted results.



THE TOUCH OF TOMORROW IN THE PLANES OF TODAY



Ranger Design Minimizes Vibration, Gains High Performance

The high specific output of Ranger in-line, air-cooled, inverted aircraft engines is directly traceable to Fairchild's advanced research and engineering in all phases of the problem of vibration.

Starting with the smoothness inherent in in-line cylinder arrangement—no cumbersome rotating masses—Fairchild engineered the Ranger's extremely light moving parts for close limits of static and dynamic balance . . . limits rigidly controlled in production by specially designed tests. The seven-bearing crankcase is fully webbed. Torsional vibration is virtually eliminated

by the unique Fairchild dynamic crankshaft damper. High speed results. Ranger's extremely efficient "pressure cooling," coupled with this high speed, produces the high specific engine output for which Ranger is justly famous . . . the most efficient and reliable engine in its power class.

ON THE BEAM

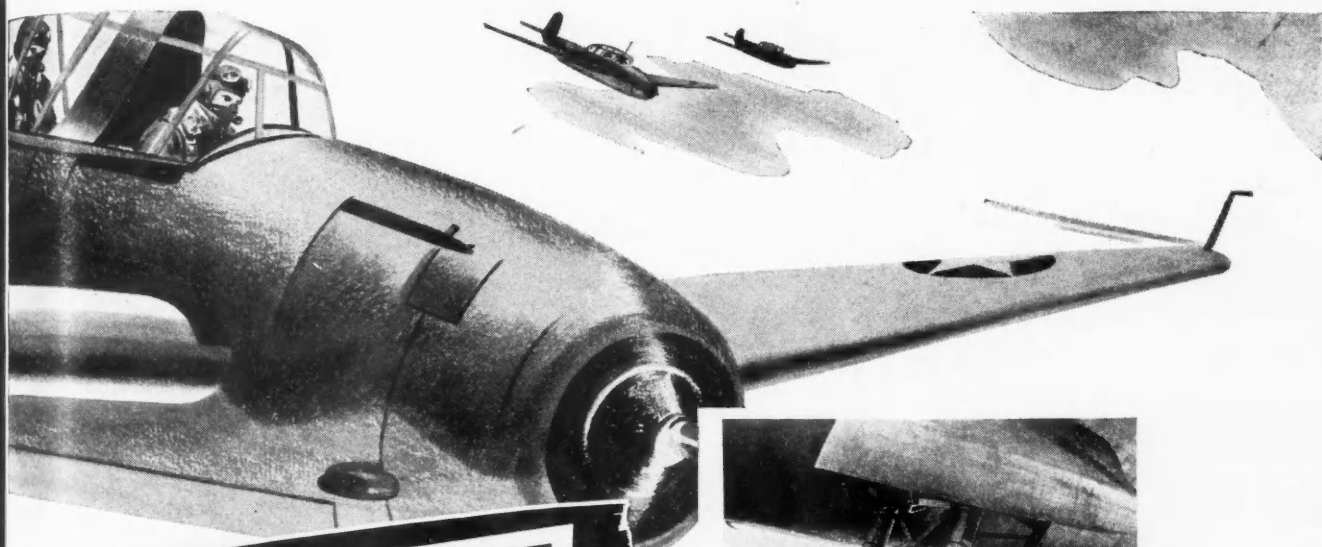
"Breathes there a man with soul so dead who never to himself hath said: 'This is my own, my native land.'" Isn't your country worth 10% of your pay check? Buy War Bonds for Victory!

In addition to its operating advantages, the Ranger also presents a low frontal area which has made possible new aerodynamic efficiency in the planes in which it is used. The "Touch of Tomorrow" engineering which created the Ranger was once undeniably "ahead of its time." But today, with the United Nations needing the ultimate in weapons for Victory, the Ranger has proved itself very much *on time*. Fairchild continues to engineer "in advance"—for timely weapons against the enemy, for timely contributions to the future of aviation.



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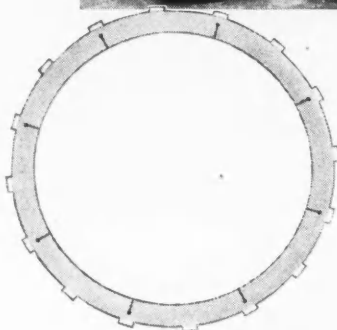
Higher and higher go America's combat planes, as engine superchargers become more powerful and dependable. Operating at speeds up to 24,000 r.p.m., the 2-stage geared superchargers are equipped with VELVETOUCH clutch facings. This amazing friction material has also proven its dependability in landing wheel brakes and in clutches on bomb doors, wing flap controls and gun turret mechanisms.

VELVETOUCH is an all-metal friction material—a combination of sintered powdered metals, compressed and welded to a solid metal backing. It is smooth and positive . . . does not jerk or slip. Specify VELVETOUCH for trouble-free operation!

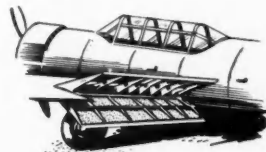
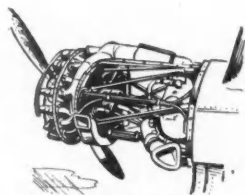
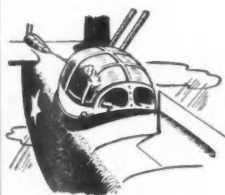
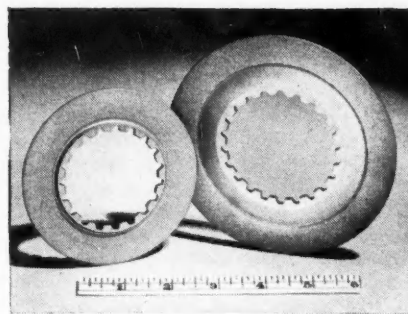


Top—Close-up of wheel assembly and landing gear.

Above—19.00-23 Goodyear airplane brake with VELVETOUCH facings. Left—one of the 13" VELVETOUCH brake discs.



Right—VELVETOUCH supercharger drive clutch discs of the type used in large aircraft radial engines.



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1374 EAST 51ST STREET
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POST-WAR WORLD?



WHAT kind of a car will satisfy a bomber pilot? Will a jeep driver take four-wheel drive for granted on the truck he handles after the war? The buses of tomorrow—what will they be like?

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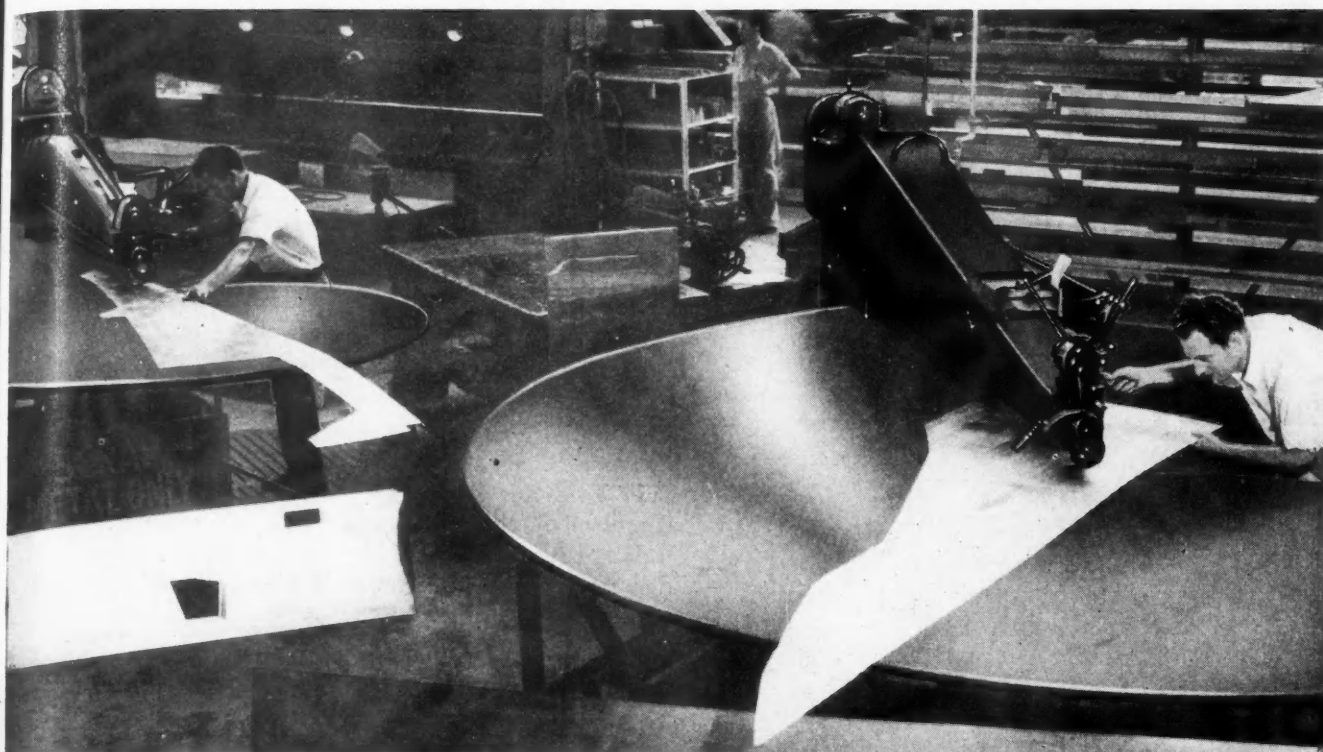
COR-TEN is very strong—its yield point of 50,000 lbs. per sq. in. min. is $1\frac{1}{2}$ times that of structural steel. Because its endurance limit is more than three times that of non-ferrous "light" metal, COR-TEN has an amazing capacity to absorb vibrations and twisting stresses that rack the life of bodies and frames. In addition, COR-TEN has high corrosion resistance—4 to 10 times greater resistance to atmospheric corrosion than plain steel.

No COR-TEN is available right now for car, bus or truck construction. What is being produced is going directly into war equipment. But COR-TEN will be available when the fighting is over. So get the facts about this superior steel and plan to use it where it will do the most good. Our engineers will be glad to give you whatever information you need.



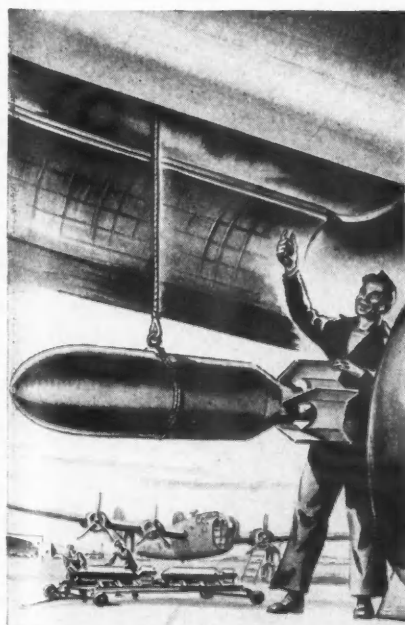
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Today, an air-minded personnel makes this broad experience available to both manufacturers and operators. An extensive Whiting line of matched aircraft maintenance and handling equipment is being produced . . . and the Whiting Collateral Engineering Service is collaborating on many of today's important aviation problems.

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Maintenance and Handling Equipment . . . Collateral Engineering Service

"Cracking" the Axis

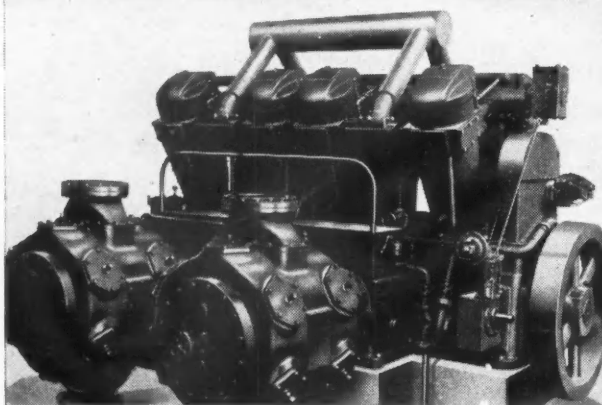
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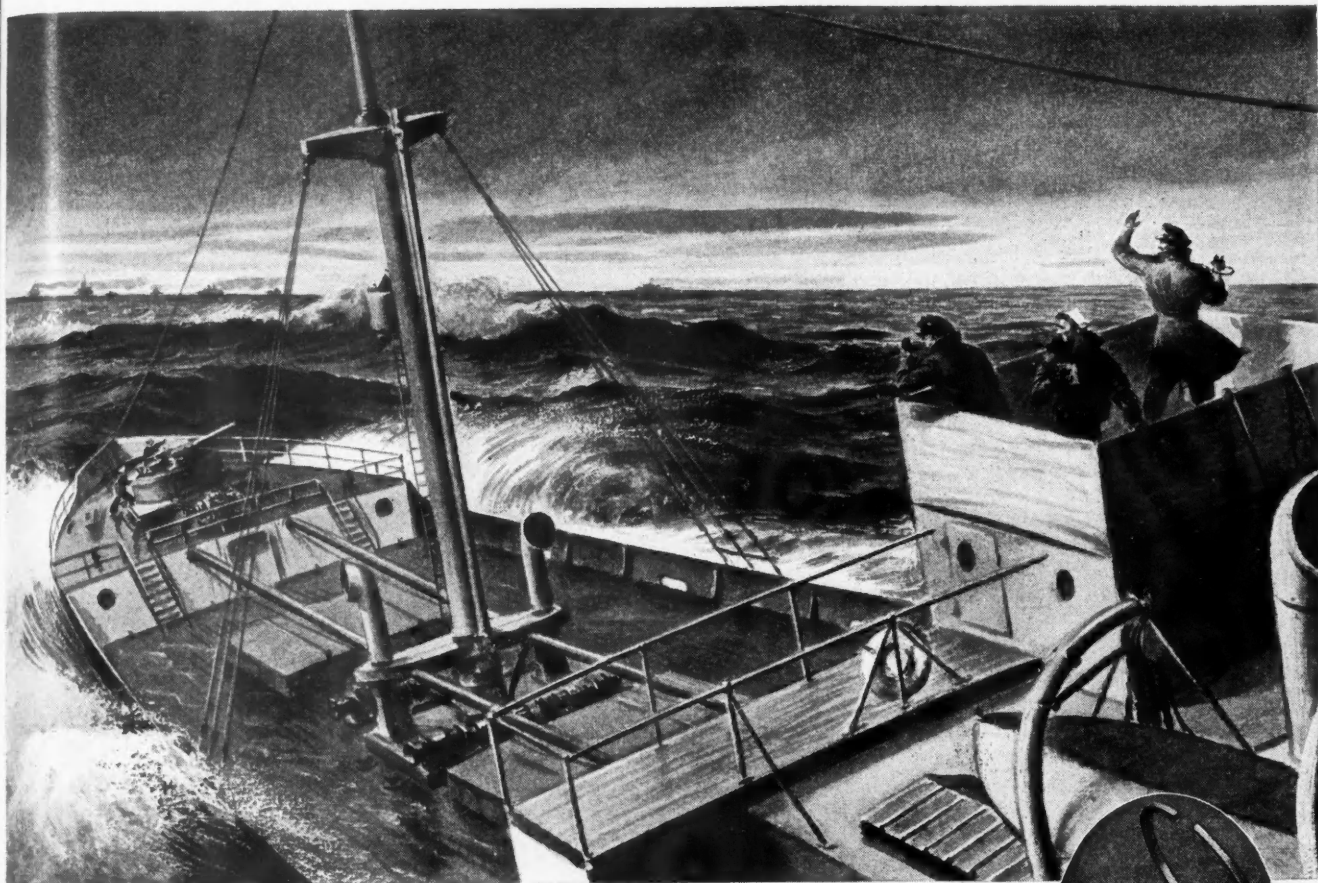


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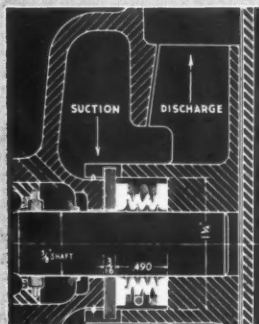
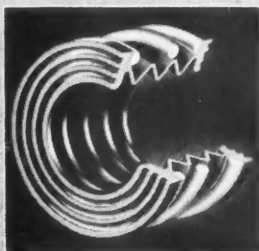
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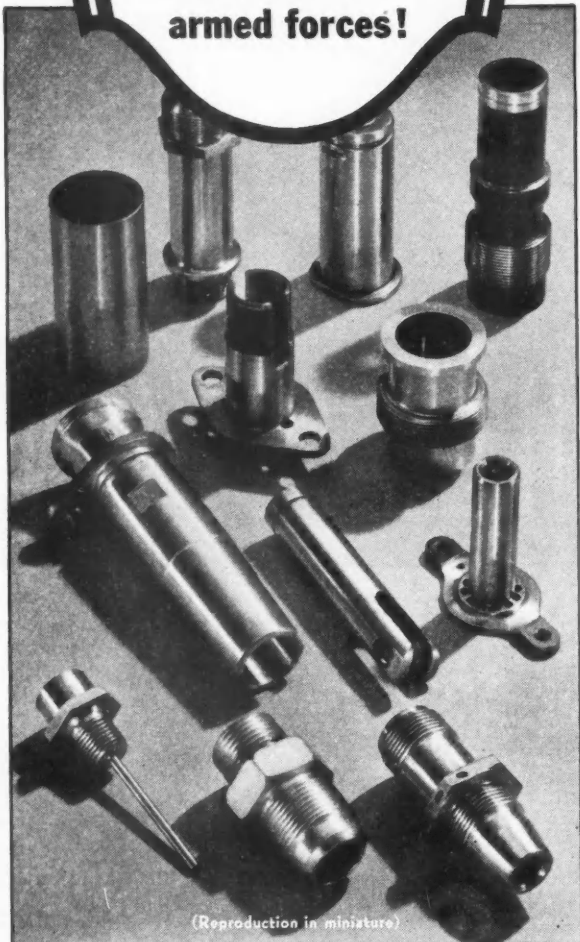
The stars, unvarying in their course, are the celestial guides of aircraft and ships. The precision of their movements assures the most complete accuracy. Precision is vital, too, in the bomb racks and shackles which we build. We were doing precision work of this type before the war...and will be doing it afterward.

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AND WHEN PEACE COMES

... we know that all of us will share in a new America. We, of Lawson, are very proud that we are able to build products to meet the exacting standards of our Navy and Army.

It means that, for the duration, we cannot make our facilities available for civilian-industrial use, but thanks to the experience we are gaining now, we will be better able and more completely equipped to serve you when peace comes.

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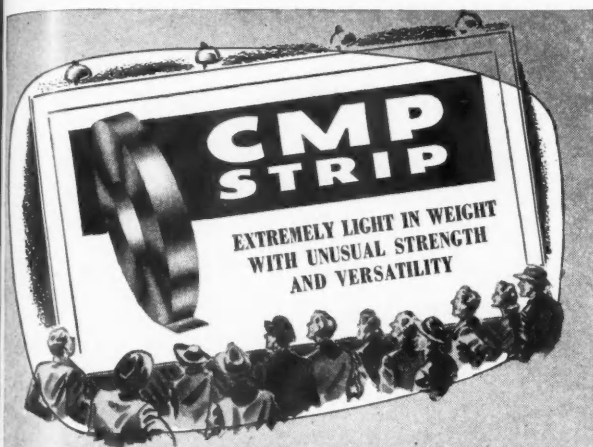


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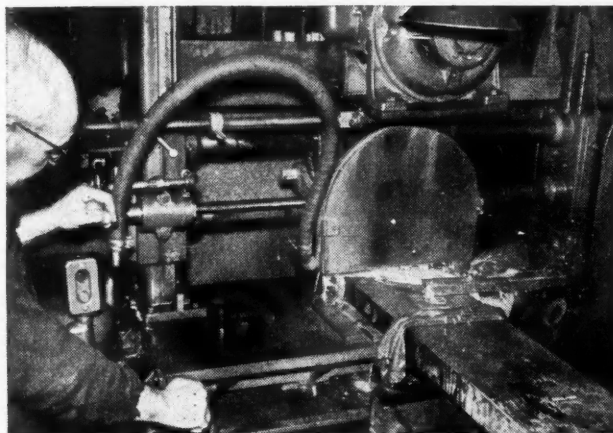
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Like the success of accomplished players, who achieve the unusual and thus attract more "box office", CMP precision cold rolled strip steel consistently delivers applaudable cost-saving qualities—exceptionally close tolerances, uniformity of properties in coil after coil, and fulfillment of all exacting specifications. It makes possible the CMP strip record performance for essential war industry. And CMP did not fail when called upon in many cases to extend its service, and replace other "gone-to-war" performers, such as critical light gauge non-ferrous metals; again CMP proved its wide adaptability by meeting the important physical characteristic requirements so that the Victory "production show" could go on.

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The COLD METAL PRODUCTS CO.
Subsidiary of the Cold Metal Process Co.
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No. 302 Campbell Abrasive Cutting Machine cutting 18/8 Stainless Steel forging blanks from slab 25/8" x 10" x 14'

Campbell DOES ANOTHER PRODUCTION CUTTING JOB THAT "COULDN'T BE DONE"

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If you write the Campbell Engineering Department, they will develop production procedure and costs for you, too, without any obligation.

State materials, shapes and sizes you are cutting. Give lengths of stock, lengths of cut-off pieces and production rate required.

The data worked up for you will be based on actual experience. Remember CAMPBELL manufactures the only complete range of abrasive cutting machines—8 types and 19 models—and these machines are currently cutting all grades of steel, annealed and unannealed, non-ferrous alloys, plastics, glass and ceramics. Solid bars, tubular and flat stock.

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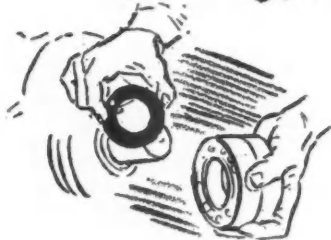


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Shims cut to your specifications. Stock shim materials obtainable from your dealer. Write us for further information and shim application chart.

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LAMINUM
THE SOLID SHIM THAT *peels* FOR ADJUSTMENT

Wanted—An Air Policy

(Continued from page 19)

quired the construction of many airports, which are suitable for peacetime transport use. By the end of this year the number of major airports in the United States, having paved runways of 3500 feet or more, is expected to reach the 865 mark (100 in 1940), while besides these there are 2000 lesser fields.

For planning future airways services in this country the Civil Aeronautics Administration estimates that by 1950 there will be 500,000 planes in private, commercial and military service. The National Resources Planning Board estimates that air travel in the United States will reach 20 million passengers, (70 per cent of present-day Pullman rail travel) within the next 10 or 20 years, that all long-haul first class mail will go by air, and that there will be regular air freight lines with feeder air lines to smaller cities and pick-up service in the villages.

In May at a forum on the future of aviation sponsored by the Society of Automotive Engineers in New York City, Ralph S. Damon, president of the Republic Aviation Corp., predicted that by 1953 there would be about 300,000 privately-owned airplanes, which is the number of motor boats that were licensed prior to the war. In the field of air transport he foresees "in United States some hundred thousand miles of modern airways, a thousand cities served regularly and many thousands of others on mail, express and perhaps passenger pick-up with transport service of one hour from New York City, every 30 minutes by air to Boston, of two hours every 30 minutes by air to Chicago, of seven hours every hour to the Pacific Coast, and overnight to London. Fanciful—yes—but practically I believe it can come true—engineering wise it is possible—let us be sure that that thing in human relations which we call politics does not stop it."

Mr. Damon approved a recent proposal made by Welsh Pogue, chairman of the Civil Aeronautics Board, to the effect that for international traffic the planes of any nation shall have non-exclusive rights to pick up and to discharge, to fly, to fuel and to service in international traffic within any other nation. Such a plan, he said, does not infringe the intra-national rights of any nation to its own cabotage, which should be reserved to each nation or granted to others by the nation involved.

He doubts that aviation will ever touch nine-tenths of existing rail, road and water transportation. Within 20 years he believes that transport planes will be cruising at 400 mph and will come close to that speed by 1950.

In the field of engineering he enumerated such developments as the counter rotating propeller, the helicopter, flying wing, rocket propulsion, operation at super-sonic speeds, assisted takeoff for planes of high wing loading,



1920
1930
1940
1943

That there is no substitute for experience is doubly true in a field so new as aviation... where accomplishment outspeeds the hand-book... trebly true in wartime when yesterday's plans are tomorrow's production.

Founded in '20
by men whose experience carried over from the pioneer rule-of-thumb days... refined in the crucible of World War One... **MERCURY** has the know how which enables aircraft makers to turn confidently to this organization for surfaces, tanks and accessories.

At the Cradle of Aviation





DELIVERIES FOR YOU ... INSTEAD OF TO YOU ...

● Although everything we make today goes to war, it is going to work for you just as surely as though we could deliver it for your own use in your own plant. For today all of America is in business for Victory, and whatever helps the war effort helps us all. Right now "Connecticut" equipment is hard at work all around the globe—precision electrical products, different in detail, but not in basic design, from the ones you'll be using after victory. Once this war is won, and present military secrets become open knowledge, you'll know about "Connecticut" products from your partners, the boys who are using them today. Chances are you'll be using many electrical devices, born of this war, to speed and control peacetime production. We hope to continue working with you then.



CONNECTICUT TELEPHONE & ELECTRIC DIVISION



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Overloading is dangerous—while today abuse to machinery is akin to sabotage.



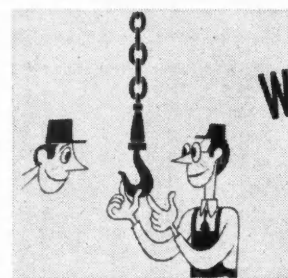
INSPECT REGULARLY!

Don't neglect your WRIGHT HOISTS. Make them last longer by regular and proper maintenance.



OIL REGULARLY!

Get busy with the grease gun! Your WRIGHT HOIST will last indefinitely if you treat it right.



WATCH LOAD HOOK!

Wright hooks are made to open slowly as visible warning against overloading. Watch them.



BUY YOUR LOAD CHAIN A DRINK!

Believe it or not, muster, a well-lubricated load chain will outlast a dry chain fifteen times.



Send today for a free copy of the Wright Crane Signal Chart. This chart (36" x 24") can be tacked up on the bulletin board to teach the men standard crane signals which will speed operation and promote safety.

WRIGHT MANUFACTURING DIVISION
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In Business for Your Safety

100 plus octane fuels, electronic devices for communication and navigation, as possibilities for making big advancements in aviation.

Mr. Damon's paper was discussed by a number of prominent executives of airline and aviation manufacturing companies. William Littlewood, vice-president of American Airlines, pointed to the development of suitable terminal facilities for the various services to be performed as one of the most important aspects of future aviation. In the long range travel field he believes cruising speeds will continue to increase to 400 mph, but in the short range field there will be no substantial increase over present cruising speeds since factors of performance, utility and economy are so important. He emphasized that in the future airports should be designed so that all elements (runways, instrument landing facilities, traffic control provisions, terminal facilities, etc.) will be in proportion to develop the full capacity of the airport with respect to its flight operations, passengers, cargo and airplane facilities, and that the operational airport be devoted to operational requirements, not limiting its capacity by shop and office requirements. Freedom of the air, he said, should be guaranteed to all peoples.

Air power has awakened mankind to the possibilities of the airplane, not only as a weapon of war, but as a useful vehicle of commerce, it was stated

by Charles Froesch, chief engineer of Eastern Air Lines. But, he said, international air commerce can only grow to its rightful place if all nations will grant to each other the right of innocent commercial flight with specific refueling points consistent with the national security and sovereignty of each nation and their trade interests.

Paul E. Hovgard, chief designer of the Glenn L. Martin Co., read the discussion of William K. Ebel, vice-president in charge of Martin engineering, who was unable to attend. So much of the future of air transportation and airplane manufacturing industries depends upon the regulations by Government, that the importance of proper organization of Federal Bureaus cannot be too highly stressed, Mr. Ebel stated in his paper.

Andre A. Priester, vice-president and chief engineer of Pan-American Airways Corp., foresees air transportation developing into three major types of operation—first, long range with flights of 2000 miles and upward; second, medium range with flights of between 1000 and 2000 miles; and third, short range with flights of less than 1000 miles.

For maximum operating efficiency in each type of operation, he pointed out, airplanes should be designed specifically for each type of operation, such as exclusive passenger and mail service, mixed passenger, mail and freight service, and exclusive mail and freight

service.

It is the opinion of Arthur Nutt, vice-president of the Wright Aeronautical Corp., that once a practical solution to the engineering problems have been found for a practical family airplane then American production manufacturing ability will take care of making the design at a popular price.

Col. Harold R. Harris, who is in charge of the Domestic Transport Division of the Air Forces Air Transport Command, made several interesting comments on aviation. In the last war the top speeds of airplanes were about $2\frac{1}{2}$ times their landing speeds while in this war the ratio is 5 times. Most military planes are either semi-suitable or unsuitable for civil application. The two most difficult problems are icing and blind landing, but they are being solved rapidly. In commenting on the freedom of the air, he reminded his listeners that it is a two-way proposition by a mutual exchange of rights.

The helicopter, small airplane and two types of roadable airplanes, one with emphasis on air performance and the other with emphasis on road performance, will come into existence after the war, according to William B. Stout, director of the Stout Research Division of the Consolidated Vultee Aircraft Corp., who addressed an SAE meeting at City College of New York. He believes unusual progress in aviation can be made after the war if free of Government control.

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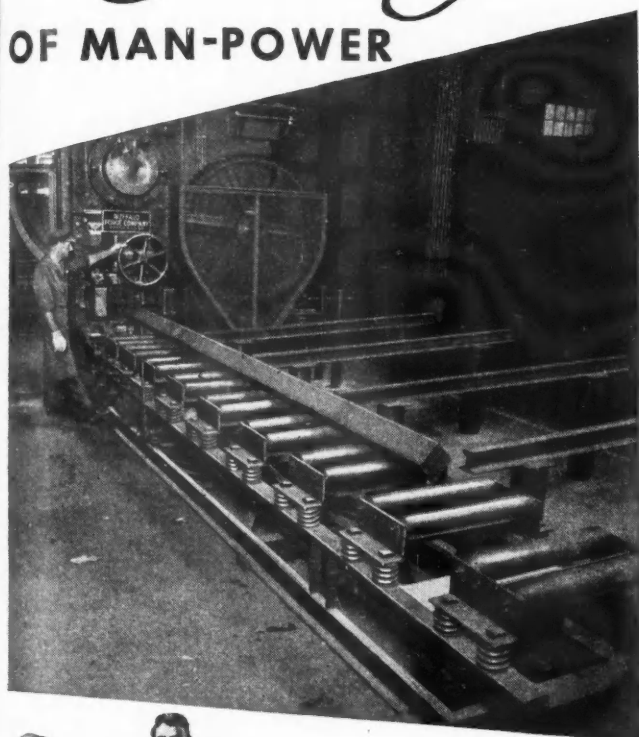
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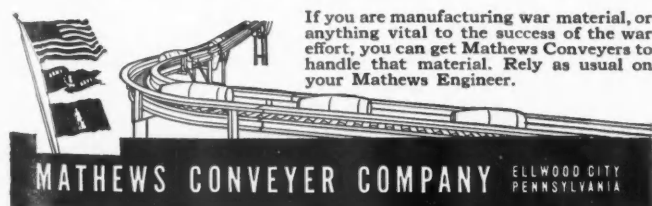
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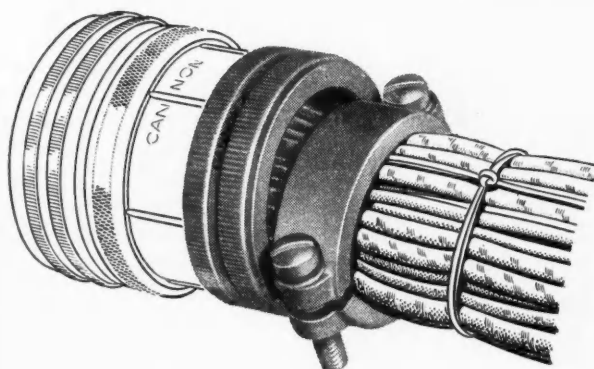
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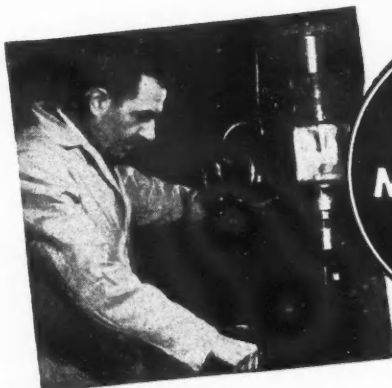
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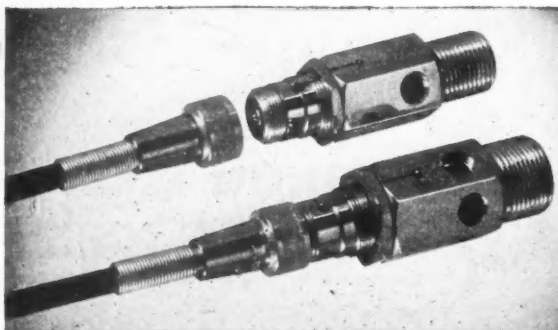
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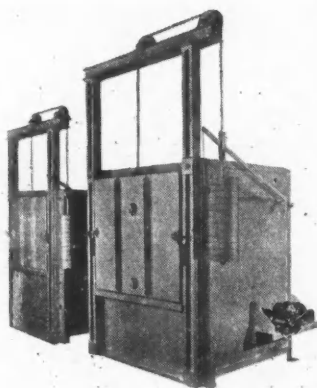
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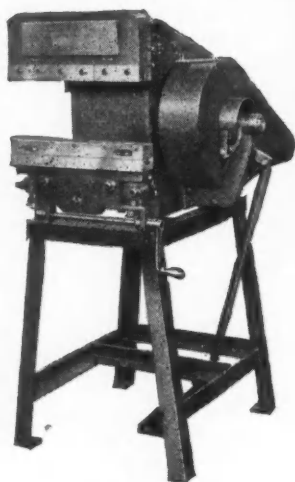
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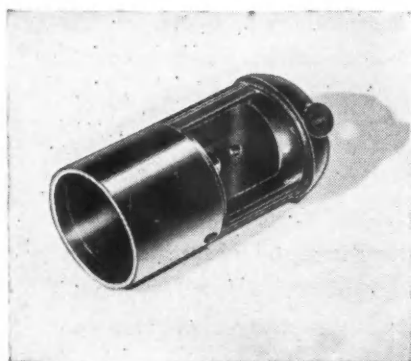
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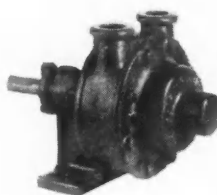
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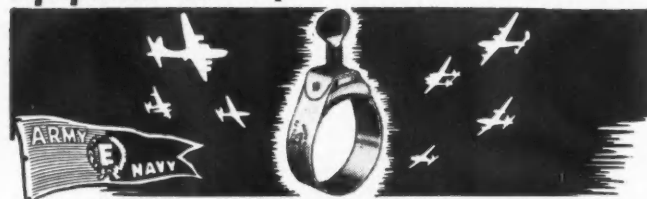
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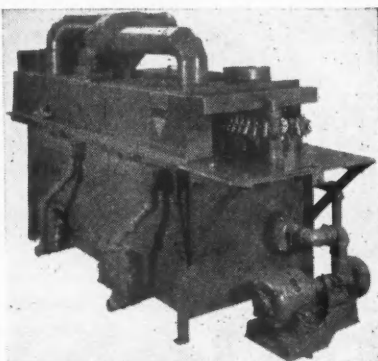


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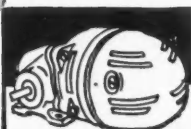
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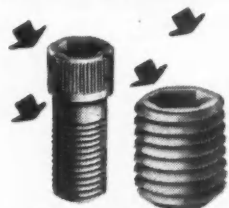
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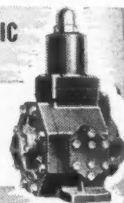
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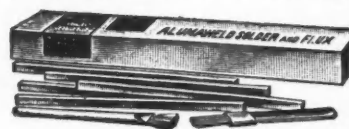
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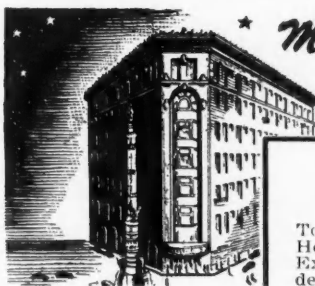
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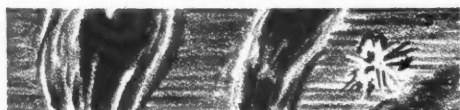
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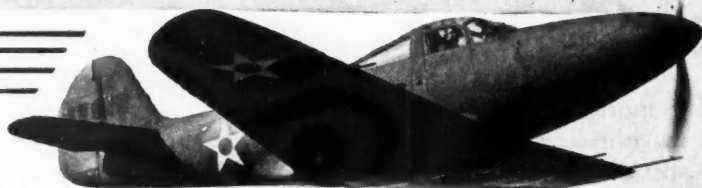


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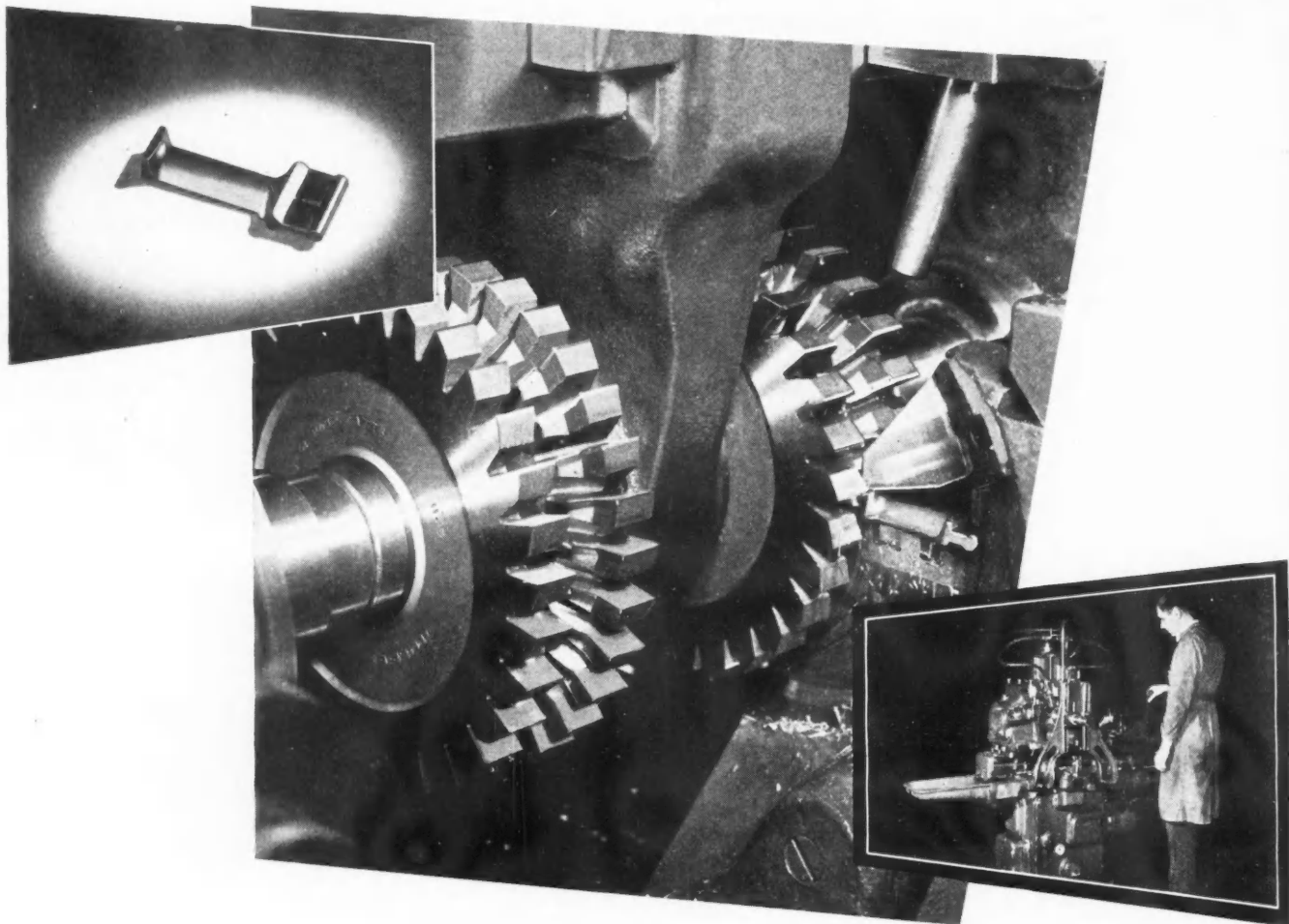
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be held within $+.0003" - .0000"$. The Barber-Colman Milling Cutters used in this operation were *pecially designed for the job* by experienced B-C small tool engineers, based on requirements of extremely fine finish and close tolerances. Their outstanding performance is full testimony of our engineering department's ability to design Better Cutters. You, too, can profit from this engineering service by taking your cutter problems to your Barber-Colman representative nearest you, or by sending the data directly to us.

PRODUCTION DATA

Material — Tough Steel, Work Hardens.
Feed — $5\frac{1}{8}"$ per minute.
Cutter Speed — 70 R.P.M.
Stock Removal — Width $\frac{1}{8}"$,
Depth $1\frac{1}{4}"$.
Machine — Sundstrand No. 1 Rigidmil.
Special table.
Holding Means — Special Fixtures.
Production — 120 pieces per hour, increase of 84%.
Pieces per Cutter Sharpening — 2000.
Production with former method — 65 per hour.

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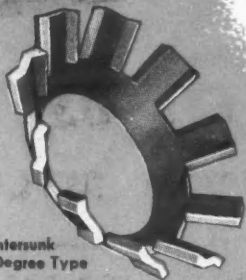
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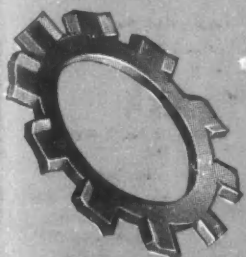
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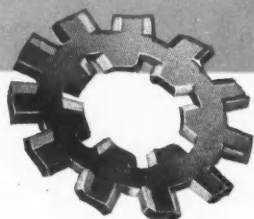
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Internal Type



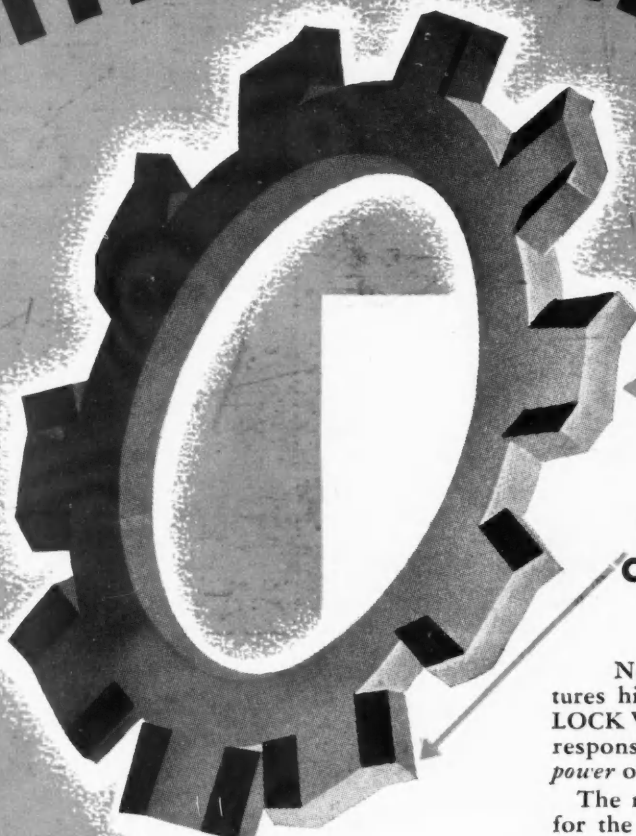
Countersunk
90 Degree Type



External Type



Internal-External Combination Type



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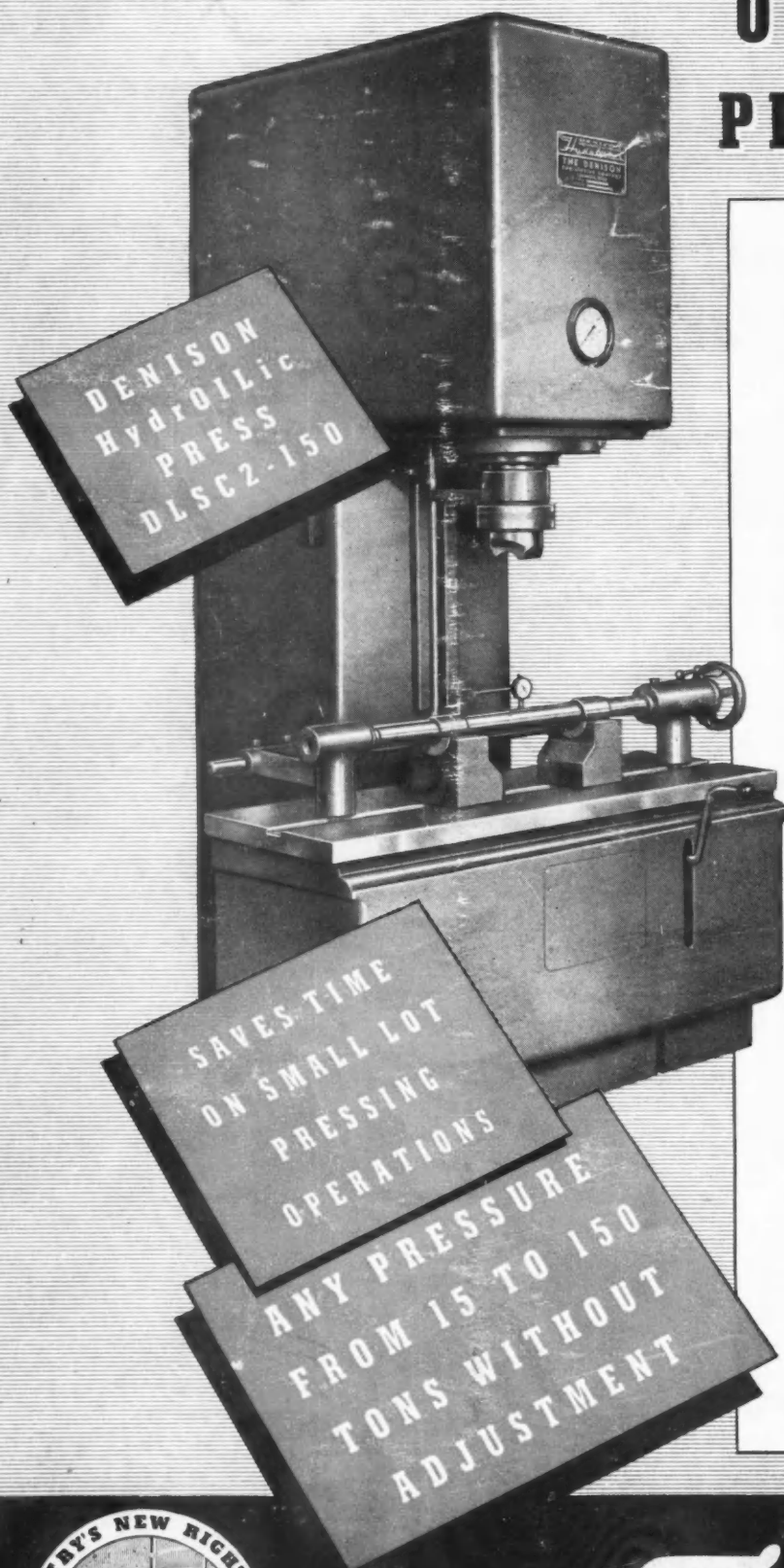
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